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THE ETHICS OF TRIBAL SOCIETY.

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THE world of the primitive man was bounded by the circle of his vision. He regarded the horizon as a fixed line which separated the earth from the sky, and which it would be possible for him to reach by going far enough. He did not deem it less real because it unfortunately always eluded his search, like the fabulous pot of gold which, according to popular superstition, lies buried at the point where the rainbow rests on the ground. In like manner the barbarian of to-day has no conception of the fact that the line of junction of earth and sky has no real existence, but is "all in his eye."

Indeed, it is but recently that man has learned to appreciate aright the wholly subjective character and significance of the terms north, south, east, and west as applied to places on the globe, and to recognize the relativity of all his geographical ideas, inasmuch as these are dependent for their accuracy and exactness upon the position of the speaker. It is one of the rare achievements of high culture, and has always been the prerogative of exceptionally thoughtful minds, to be able to distinguish between the apparent and the actual, to keep mental conceptions free from the influences of optical illusions, and not to be deceived by the surprises and sophistries of the senses.

An old English legend entitled The Lyfe of Adam, which has been preserved in a manuscript of the fourteenth century, relates how "Adam was made of oure lord god in the place that Jhesus was borne in, that is to seye in the cite of Bethleem, which is the myddel of the erthe." It then goes on to state that the first man was made out of dust taken from the four corners of the earth,

which meet in Bethlehem, and that he was called by a name composed of the four principal planets: thus he was formed as a microcosm, the miniature counterpart and organic epitome of the universe, the synopsis and symbol of all created things.

There is a tendency in every savage tribe and isolated people to regard the portion of the earth which it happens to inhabit, and especially the spot which is the cradle of the race or around which its sacred traditions cluster, as not only the political and religious but also as the physical center of the world. Such were Jerusalem to the Jews and imperial and papal Rome, *urbs et orbis*, to the ancient Romans and mediæval Romanists; such has Benares been from time immemorial to multitudes of Hindus, and such is Mecca to-day to millions of Moslems. Before the discoveries of the Western hemisphere, made by Columbus and his compeers, not even the most enlightened peoples had any proper sense of their relations to the rest of mankind, either morally or geographically. International ethics and comities began with the growth of clearer and more correct ethnical notions, and have always kept pace with it. The knowledge of the rotundity of the earth gave a strong and permanent impulse in this direction, and has contributed not a little to the recognition of the equal rights of all races of mankind.

The language of every civilized nation contains curious survivals of the primitive conceptions which sprung out of what might be called the self-conceited and self-centered spirit of the savage. It is interesting to note how a single people, emerging from barbarism and taking the lead in civilization at an early period, imposes its forms of speech, and especially its geographical terms, upon after ages and upon remote races of men for whom they have really no meaning. We still speak of certain countries as the Levant and the Orient, the Ἀνατολή of the Greeks, but these designations have no significance except for the dwellers on the shores of the Mediterranean, with whom they originated. So, too, Asia means etymologically the land of the rising sun and Europe the land of the setting sun, and these names expressed the actual position of the two continents in their relation to the Greeks. But to an American, and especially to a Californian, Europe is an Eastern and Asia a Western continent, and these strictly ethnocentric appellations would be wholly unsuitable and extremely confusing were it not for the fact that their etymology has become obscured and their primitive signification been forgotten, or is at least lost sight of and ignored, so that they are now mere arbitrary terms or distinguishing signs, with no suggestion of the geographical direction or situation of the regions to which they are applied, just as we speak of Chester, Edinburgh, Oxford, Berlin, or Munich without thinking of a Roman camp, King Edwin's castle, a ford

for oxen, a frontier fortress, or a community of monks; and christen a child George, Albert, or Alexander without intending him to be a tiller of the soil, or wishing to imply that he is of noble birth, or will distinguish himself as a defender of men. All such proper names denote particular places or persons, but have wholly ceased to *connote*, as the scholastic philosophers were wont to say, the qualities or attributes which were at first associated with them and brought them into use.

The Chinese call their country the middle realm (*Chung-kuĕ*) or the flower of the middle (*Chang-hua*), thus characterizing it as the central and choicest portion of the earth, in distinction from the savage wastes inhabited by savage men outside of the Great Wall (*Wan-li-ch'ang-ch'ing*). The Jews looked upon themselves as the chosen people, set apart as *Yisrâĕl*, or champions of the true God, and lumped all other tribes of men together as *goïm*, gentiles, poor pagan folks, who had no rights which a child of Abraham was bound to respect. The Greeks divided all mankind into two classes, Hellenes and barbarians; the latter were also called ἄγλωττοι—i. e., tongueless—because they did not speak Greek. Aristophanes applied the term βαρβαροι even to birds, on account of the inarticulateness and unintelligibleness of their chirpings and chatterings. It is from Greek usage that we have come to designate any corruption of our own language by the introduction of foreign or unfit words as a barbarism. The persistence of this primitive tribal conceit is shown by the fact that a people in many respects so cosmopolitan as the English can pronounce no severer censure and condemnation of the manners, customs, and opinions of other nations than to call them un-English, and really fancy that an indelible stigma attaches itself to this epithet. Not long since several British tourists in Italy actually protested against some foolish, perhaps, but otherwise harmless features of the Roman carnival, and demanded their suppression on the ground that they were "thoroughly un-English," thus virtually assuming that no amusements should be tolerated on the Tiber which were not customary on the Thames. It is due to the same feeling that the word "outlandish" has gradually grown obsolete in its original sense, and is now used exclusively as an expression of contempt. Slavonic (*slovene*) is derived from *slovo* (speech), and means people with articulate language; whereas the Slavic nations call the Germans *Nĕmĭcĭ*, which signifies speechless, dumb, and therefore barbarian.

Geocentric astronomy and ethnocentric geography have been relegated long ago to that "limbo large and broad" which is the predestined receptacle of all exploded errors and illusions engendered by human vanity and ignorance; but from the bondage of ethnocentric ethics, manifesting itself in national prejudices and

prepossessions, and often posing as a paragon of virtue in the guise of patriotism, even the most advanced and enlightened peoples have not yet fully emancipated themselves. The Hebrews thought they were doing the will of their tribal god (the personification of the tribal conscience) by borrowing jewels and fine raiment from their too-obliging Egyptian acquaintances and then running away with them. That this mean abuse of neighborly confidence and civility was not a mere momentary freak of fraudulence or sudden succumbing to temptation, but the outcome of settled principles of morality and a general rule of policy, is evident from the approval with which it is recorded, as well as from the laws subsequently enacted, which permitted them to take usury of aliens and to sell murrain meat to the strangers in their gates.

This is the kind of ethics which finds expression in the legislation of all barbaric and semi-civilized races, from the Eskimos to the Hottentots. The Balantis of Africa punish with death a theft committed to the detriment of a tribesman, but encourage and reward thievery from other tribes. According to Cæsar's statement (De Bello Gallico, lib. vi, c. 23), the Germans did not deem it infamous to steal outside of the precincts of their own village, but rather advocated it as a means of keeping the young men of the community in training and rendering them vigilant and adroit. But we need not go to African kraals or American wigwams or primeval Teutonic forests for illustrations of this rule of conduct. Quite recently a Frenchman succeeded as *commis-voyageur* in swindling a number of German tradesmen out of large sums of money, and was applauded for his exploit by Parisian shopkeepers, who readily condoned his similar but slighter offenses against themselves on account of the satisfaction they derived from the more serious injury done to their hereditary foes on the Rhine. This incident proves how easy it is for the primitive feeling of clanship, euphemistically styled patriotic sentiment, to put in abeyance all the acquisitions of culture and set the most elementary principles of honesty and morality at defiance. International conscience is a product of modern civilization, but it is still a plant of very feeble growth—a sickly shrub, whose fruits are easily blasted, and for the most part drop and decay before they ripen.

Sir Henry Sumner Maine, in his Lectures on the Early History of Institutions, has shown with admirable force and suggestiveness that rude and savage tribes uniformly regard consanguinity as the only basis of friendship and moral obligation and the sole cement of society. The original human horde was held together by the same tie of blood-relationship that produces and preserves the consciousness of unity in the animal herd or causes ants and

bees to lead an orderly and mutually helpful life in swarms. In all these communities the outsider is looked upon as an outlaw; whoever is not a kinsman is a foe, and may be assailed, despoiled, enslaved, or slain with impunity. Indeed, it is considered not only a right but also an imperative duty to injure the alien by putting him to death or reducing him to servitude. The instinct of self-preservation asserts itself in this form with gregarious mammals and insects; and all primitive associations of men are founded upon this principle and cohere by force of this attraction.

A superstitious regard for blood pervades all early ideas and institutions of mankind. The ancient Hebrews were forbidden to eat the blood of a slaughtered animal, because the blood is the life; and the orthodox Israelite still clings to this notion and will not partake of butcher's meat that is not *gosh* or ceremonially clean—i. e., from which the blood has not been carefully drained off, although he knows that this process of ritual purification deprives the flesh of much of its succulence and nutritive value as food.

It is a widely diffused belief among aboriginal and lower races that the blood is the seat of the soul; hence blood-relationship is synonymous with soul-relationship. The child was also recognized as a blood-relation of the mother, but not of the father. Out of this conception of consanguinity arose the custom of descent in the female line, whereby the children of a man's sister became his heirs to the exclusion of his own offspring. Curiously enough this notion is confirmed, to some extent, by modern science, which would ascribe to the female the function of conserving and transmitting the permanent qualities and typical characteristics of the race, whereas the influence of the male in propagation is variable, innovating, and revolutionary, and tends to produce deviations from the hereditary norm.

Cannibalism, too, as a tribal rite, originated in the belief that the soul resides in the blood, and that by drinking the blood of the bravest foemen their courage, cunning, and other distinctive and desirable traits may be acquired and thus serve to increase the fighting force and efficiency of the tribe.

Brotherhood was also created artificially or ceremonially by mingling a few drops of the blood of two persons in a cup of wine and drinking it. Each received into his veins a portion of the other's blood, and thus they became blood-related and were bound by the same mutual obligations as they would have been if the same mother had given them birth. The heroes of old German sagas are represented as drinking brotherhood in this manner; it is thus that Gunther and Siegfried swear inviolable friendship and fidelity in Wagner's *Götterdämmerung;* and German students, in the festive enthusiasm of a *Commers,* are fond of imi-

tating their mythical forefathers in the solemn celebration of this mystic rite.

It is interesting to note the rhetorical and metaphorical survivals of this once strong conviction. In referring to political parties in France the Journal des Débats recently remarked: "It is not true that our nation consists of two nations—the heirs of the Emigration and those of the Revolution. This distinction no longer exists. The last vestiges of it have been obliterated on the battlefields, where all Frenchmen have mingled their blood. France is henceforth one and indivisible."

The noble sentiment expressed by the Greek comic poet Menander and handed down to us in the language of Terence, his Roman imitator, "I am a man, and regard nothing human as alien to me," was doubtless shared by many individual thinkers of antiquity, especially among the Greek Stoics and their Roman disciples. Cicero, who may be taken as one of the most eminent representatives of this ethical school, lays great stress upon "love of mankind" (*caritas generis humani*), in distinction from the love of kindred or countrymen. "A man," he says, "should seek to promote the welfare of every other man, whoever he may be, for the simple reason that he is a man"; and declares that this principle is the bond of universal society and the foundation of all law. He returns to this topic again and again, and never tires of enforcing this doctrine as fundamental in his treatises on duties (*De Officiis*), on the highest good and evil (*De Finibus Bonorum et Malorum*), and on laws (*De Legibus*). That he regarded this broad, cosmopolitan view as a new departure in ethics is evident from his remark that "he whom we now call a foreigner (*peregrinum*) was called an enemy (*hostis*) by our ancestors."

The distinguished Christian apologist Lucius Lactantius bases the duty of human kindness upon the hypothesis of human kinship, thus reviving and amplifying the old tribal notion which limits moral obligation to those who can claim a common progenitor. "For, if we all derive our origin from one man, whom God created, we are plainly of one blood; and therefore it must be deemed the greatest wickedness to hate a man, even though he be guilty." He adds that "we are to put aside enmities and to soothe and allay the anger of those who are inimical to us by reminding them of their relationship. . . . On account of this bond of brotherhood God teaches us never to do evil, but always to do good." He also quotes a passage from the Epicurean Lucretius to the effect that "we are all sprung from a heavenly seed and have all of us the same father"; and draws from this statement the conclusion that "they who injure men are to be accounted as savage beasts."

Lactantius has been surnamed the Christian Cicero, but the

fundamental principle of his ethics, as formulated in his Divine Institutions, is in its motive character and moral elevation far below the height attained four centuries earlier by his pagan prototype. The results of their teachings, practically applied, were equally cosmopolitan; inasmuch as Lactantius based his theory of duty on the Hebrew legend of the origin and descent of man, and thus enlarged his essentially tribal system of ethics so as to embrace the whole human race.

Marcus Aurelius defines his own ethical and humanitarian standpoint with his wonted epigrammatic terseness: "As an Antonine, my country is Rome; as a man, it is the world." Unfortunately, the liberal spirit of the philosopher, even when he happens to sit upon a throne, seldom exerts any direct and decisive influence in liberalizing the minds of the masses of mankind. Homer praises the kind and sympathetic heart of him who treats the stranger as a brother. But this fine sentiment does not change but rather confirms the fact that, as a rule, strangers were not thus treated in the Homeric age. As a general statement it remains true that in ancient times aliens had no legal rights whatsoever, and that international relations, so far as they existed at all, were relations of hostility.

But this outlawry *de jure* was mitigated *de facto* by investing the rite of hospitality with a certain sacredness. Such is still the case with all savage and semi-civilized tribes, as, for example, with the Bedouins, who hold the person of a guest inviolable, even though he may be their deadliest foe. This custom originated in the defenseless and helpless condition of the stranger, whose alienage placed him beyond the pale of law and the sphere of sympathy; it furnished a sort of compensation for the lack of all natural or conventional claims to protection, and thus supplied a temporary *modus vivendi*, without which intertribal intercourse would have been absolutely impossible.

We have an indication and illustration of this peculiarity of primitive society in the story of Cain, who, as a fratricide, was not only guilty of murder (a matter of comparatively small moment in the eyes of the aboriginal man), but also of treason against the tribe by violating the law of brotherhood fundamental to its constitution and essential to its existence; and when, by reason of this crime, he was driven out of the sheltering circle and sanctuary of his own kith and kin and became a fugitive and vagabond in the earth, his first feeling was the fear lest he should be slain by any stranger who might chance to meet him. The Lord is also represented as recognizing the possibility of such a catastrophe, and as setting a mark upon him in order to avert it.

The stipulation contained in the Hebrew code, as well as in the code of other Eastern nations, which made it the duty of a man to

wed his brother's widow, provided the first union was childless, and to raise up seed to the deceased, was only a modification of polyandry and differed from the conjugal relations still in vogue among the Thibetans in the fact that the possession of the same wife was successive instead of simultaneous. Both of these matrimonial customs are survivals of the earliest form of marriage, which was not individual, but tribal. We have a relic of this primitive kind of wedlock among the Californian Indians, who practiced promiscuous sexual intercourse, so far as the members of the same tribe were concerned; the woman was regarded as faithless or adulterous only when she cohabited with a man belonging to another tribe.

The Greeks, with all their superior culture, never became as a people sufficiently enlightened to lay aside their deep distrust and depreciation of foreigners. Sparta was notoriously hostile to strangers (ἐχθρόξενος, or guest-hating), and how impossible it was for even a cultivated Athenian to look at the world at large from any but a strictly Hellenic point of view is curiously and comically illustrated in the drama in which Æschylus glorifies the battle of Salamis, where the Persians are made to speak of themselves as barbarians balked of their purpose, and to describe their lamentations over their defeat as dismal barbaric wailings.

It is a somewhat surprising and quite significant concession to Greek arrogance that Plautus should use the phrase *vortere barbare* in the sense of turning or translating into Latin. It is possible, however, that he may have borrowed this phrase from Philemon and other Greek playwrights, whose comedies he imitated with more or less freedom, but always with a touch of native genius. Still, we know that the Romans were uniformly called barbarians, and seem to have recognized the correctness of this appellation down to the age of Augustus, when the term began to be applied chiefly, if not exclusively, to the Germans. As our earliest information concerning the Germanic peoples was derived from Greek and Roman sources, we have been misled by the use of this depreciatory designation to think of them as wild and lawless hordes, and to form a wholly false conception of the grade and quality of their civilization.

When individuals of different race or nationality formed friendships they were wont to confirm the pact by an exchange of tokens, which remained as heirlooms in their respective families, and were prized by their descendants as pledges of mutually kind and hospitable treatment. The duty of helpfulness was, in such cases, quite as imperative as is the vow of *vendetta*, which passes as a precious inheritance of hatred from Corsican father to son. These tokens were called by the Greeks σύμβολα, and by the Romans *tesseræ hospitales*, and, although they were eventually

superseded by better and more comprehensive methods and ended by playing only the frivolous part of a sentimental pastime in social life, like the modern philopena, they had originally a more serious purpose and were of no small importance as means of promoting intertribal intercourse and thus encouraging trade and leading to the establishment of commercial treaties.

Another step toward the realization of the conception of human brotherhood was the custom established at a very early period whereby chiefs of tribes came to address each other as kinsmen and members of one family. This assumption of consanguinity, which originated in the desire of dynasties to strengthen their position and to perpetuate their power, naturally led to increase of friendly intercourse and to frequent intermarriages, so that they finally became in fact what they at first claimed to be by a polite and politic fiction. Traces of this usage are found in the oldest records of royalty. Among the treasures of the Berlin and British Museums are preserved two hundred and forty-one tablets of cuneiform inscriptions containing letters written to Amenophis III and Amenophis IV of Egypt by Burnaburiash, King of Babylonia, and Dushratta, King of Mesopotamia, which show that, at least sixteen centuries before the Christian era, "dear brother" was the ceremonial title of salutation which monarchs were wont to use in their epistolary correspondence. This feigning of a common lineage still survives among crowned heads, and the vilest plebeian adventurer who, by force or fraud, gets himself proclaimed king or emperor is admitted to the select circle of sovereigns and greeted as "dear cousin."

Principles, once grown obsolete, are denounced as prejudices; religious beliefs, which have been supplanted by superior creeds, are scoffed at as superstitions; and dethroned deities haunt the imagination of their former worshiper as demons. In like manner, the lower classes of civilized communities correspond, in a measure, to the lower races, and reflect atavistically the ideas and passions of primitive man; and in periods of great social and political upheaval we are often rudely brought face to face with tumultuous masses of these strata of palæozoic humanity violently and unpleasantly thrown to the surface. It crops out in the English boor, who at the sight of a stranger is ever ready to "'eave 'arf a brick at 'im," and would deem the neglect of this duty a treasonable lack of local patriotism and loyalty to time-honored tradition; in the Cretan herdsman, who instinctively seizes his cudgel whenever a traveler in trousers passes by; and in the Egyptian fellah, who teaches his children to spit at every man with a hat on and cry out: "*Yá nasránty! Yá khinzír!* O you Nazarene! O you pig!"

The publican, in some parts of southern Italy, is still disposed

to reckon with the foreigner as a foe, a forlorn vagabond, whom it is his native-born privilege to spoil. The blood of his ancestor, the brigand, courses in his veins, and his first impulse is to plunder the wayfarer. Prudence and the police may curb this progenital, predatorial proclivity; but the self-restraint always costs an effort, and, as a compromise with his instinctive feelings, instead of relieving the guest of his purse by force, he robs him of an undue portion of its contents by adding two or three hundred per cent to the usual price of fare and lodgment.

In many cantons of Switzerland, and especially in the Bernese highlands, we have the spectacle of a whole people apparently born and bred to consider mountain passes, romantic valleys, glaciers, and waterfalls as so many traps for curious and unwary tourists, and to prize sublime scenery merely as a ready-made snare to catch coots, dupes, gulls, boobies, and other varieties of too confiding summer birds of passage, which the categorizing mind of the German has reduced to two essentially distinct but closely connected classes, *Bergfexen* and *Sommerfrischler*.

This clannish spirit even invades and desecrates the courts of justice, and the Helvetian Themis is especially notorious for her propensity to blink the legal rights of the case and to tip the balance in favor of her cantonal or federal compatriots as opposed to the stranger within her gates.

In France the *droit d'aubaine* or *jus albinagii* confiscated to the crown the property of all aliens who died within the limits of the realm, to the exclusion of the natural heirs, unless these happened to be the king's subjects. This barbarous law was abolished by a decree of the National Assembly on the 6th of August, 1790, but was re-enacted twelve years later and incorporated in the *Code Napoléon*, modified, however, by a clause making the testamentary capacity of aliens dependent upon reciprocity; in other words, it was stipulated that the will of a foreigner should be declared valid in France, provided the laws of the said foreigner's country placed on the same footing the will of a Frenchman deceased within its jurisdiction. On the 14th of July, 1819, the *droit d'aubaine* was finally abrogated throughout the entire kingdom, after having been already considerably mitigated and partially annulled by the municipal authorities of Lyons and other industrial and commercial cities, which found this relic of mediæval legislation a serious obstruction to foreign trade.

Akin to this system of right was the German *Wildfangsrecht* or *jus wildfangiatus*, also known as *jus kolbekerlii*, which, as the term implies, accorded to human beings the privilege which game laws guarantee to the quarry, namely, that of being legally hunted. *Kolbenrecht* is equivalent to club law. An old and often quoted proverb, *Kolbengericht und Faustrecht ward nie schlecht*—the

law of the strong was never yet wrong—is the cynical expression of protesting submission to the inevitable, recognized as outrageous. It is the same bitter sarcasm that mocks at unjust and irresistible power in the popular saying, "Might makes right"; it is despair taking refuge and finding relief in ironical humor, which turns the first principles of ethics topsy-turvy.

Wildfangsrecht was originally applied to fugitive serfs and to strangers, but was soon extended to bastards and bachelors, gleemen and professional champions in ordeals by battle, all of whom lived more or less in a state of outlawry as to their persons and property, and could, under certain circumstances, be reduced to the condition of chattels. Foreigners who could prove the place of their nativity were subjected to a poll tax (*cherage*) for the protection vouchsafed to them by the reeve or *Vogt*, and were therefore called *Vogtleute*. In the Canton de Vaud and elsewhere in Switzerland this pollage is still levied as *permis d'établissement*, a lingering vestige of mediæval extortion which the most enlightened European governments have now abolished. Persons of unknown origin were treated as waifs (*épaves*), the mere flotson and waveson on the drifting tide of humanity, and were liable to be seized and envassaled by any petty lord on whose territory they chanced to strand. Perhaps a diligent study of these old laws might suggest to American legislators some drastic means of purging the country of tramps.

In "the good old time" in England any alien could be arrested and punished for the crimes and misdemeanors of other aliens, although having no complicity with them. They were all lumped together as a class, any individual of which was liable to be apprehended and held accountable for the debts incurred or for the offenses committed by any other individual of the class.

The idea of justice implied by such a proceeding corresponds to that entertained by the aboriginal Australian or American, who, when his wife dies, feels himself in duty bound to kill the wife of some member of another tribe, and avenges an injury inflicted upon him by a white man by slaying the first white man he happens to meet. The loss or offense, whatever it may be, is tribal, and is satisfied with tribal expiation or retaliation.

A case of this kind occurred quite recently in Dakota. A Sioux Indian, on the death of his squaw, went forth from his lodge with his gun and shot a missionary who was passing by. The red man had no grudge against the white man as an individual; on the contrary, he was personally fond of his victim, from whom he had received many acts of kindness; but the vow of vengeance was as sacred as that made by Jephthah the Gileadite, and had to be as religiously kept.

The old English custom, just referred to as a survival of the

earliest and crudest conception of tribal ethics, prevailed at least as late as the reign of Edward III—i. e., till about the middle of the fourteenth century; and long after this period it was exceedingly difficult to enact and almost impossible to enforce laws for the protection of foreigners, so deeply rooted and intense was the prejudice against them. Even far down into the eighteenth century they continued to be regarded with extreme suspicion, and were often subjected to gross indignities, independently of any personal qualities or any peculiar conduct on their part. The mere fact of their alienage sufficed to kindle against them the anger of the populace and turn the masses into an unruly mob. This is still the mental attitude of the cockney, and cockneyism is only a local form of philistinism by no means confined to the precincts of Bow Bells.

The laws of Venice, as expounded by Portia in the case of Shylock *vs.* Antonio, discriminated against aliens as opposed to citizens in a manner extremely fatal to the plaintiff and exceedingly characteristic of mediæval legislation.

Under the influence of the political panic caused by the excesses of the French Revolution, Lord Grenville succeeded, in 1793, in persuading the British Parliament to pass an alien bill, in which the spirit of feudalism reasserted itself; and since the abolition of this retrogressive law, which was effected chiefly through the enlightened energy of George Canning, the leaders of the Tory party have repeatedly endeavored to re-enact it. In every age and every country landed aristocracies have always shown a marked tendency to narrowness, provincialism, and distrust in their international relations. Indeed, from time immemorial, agricultural communities have been excessively conservative in this respect and hostile to progress; whereas commercial states and cities, whose prosperity is in proportion to their cosmopolitanism and dependent upon it, are naturally philallogeneal (to coin a word from the Greek of the Alexandrian patriarch Cyril, who unfortunately seldom exemplified in his conduct the virtue expressed by the epithet), or friendly to foreigners and easily accessible to influences from without.

Even in America, where all portions of the population are more mobile and undergo more rapid and radical changes than in other lands, the farmers are notoriously tenacious of old ideas and suspicious of reformatory movements of all kinds, following their traditions and clinging to their prejudices long after artisans and other handworkers of the manufacturing centers and large cities have cast aside these notions as obsolete and injurious.

All European governments appear to be periodically or epidemically affected with spasms of antipathy to aliens. France suffered from a particularly severe attack of this sort just before

the Napoleonic *coup d'état*, and now betrays serious symptoms of a relapse, which it is to be hoped do not portend an imperial restoration. As a rule, such manifestations may be regarded as evidences of internal derangement, which is pretty sure to break out sooner or later in some violent disorder. Knownothingism in the United States was the symptom of such a crisis, although its indications were at that time only partially understood.

It is but recently, in fact, that civilized nations have rid themselves of the most obnoxious relics of ethnocentric prejudice in their legislation—such, for example, as the *gabella hereditaria*, which discriminated against foreigners in matters of inheritance; and the *detractus personalis*, which virtually punished emigration by the imposition of a heavy fine. These vestiges of vassalage were removed from the statute-books of the German states in relation to each other by the acts of federation of 1815, and have been successively abolished between Germany and other countries by independent treaties.

The English law of extradition with other European powers still refuses to deliver up or to prosecute an Englishman who has committed a felony in a foreign land, unless the crime has been committed against one of his own countrymen. Some years ago a case of this kind occurred in Zurich, and still more recently in Munich. In the latter instance, one of the burglars, although residing in London, proved to be an American by birth, and was therefore handed over to the Bavarian police, and finally sentenced to ten years' imprisonment, while his English confederate in crime was set at liberty. Here we have, as the result of insularism, a survival of ethnocentric ethics in its crassest and most offensive form, such as one would expect to find only among a people still in the tribal stage of development.

In the volume already cited, Sir Henry Sumner Maine not only shows kinship to have been the original basis of society, but also indicates the process by which mankind may have gradually grown out of this primitive condition. The head of the family soon became through natural increase the head of a clan or tribe. The patriarch possessed the authority and exercised the functions of a chieftain over his lineal and collateral descendants, who were known as his men and were called by his name. He was honored and obeyed as their first man, *Fürst*, or prince, their stem-sire or king, an appellation which has nothing to do with personal "canning" or cunning, as Carlyle, in his excessive admiration of human force and faculty, would fain make us believe, but refers solely to race (*kuni*). The ruler was an ethnarch in the strictest sense of the term, and held his position by virtue of his primogenitureship or procreative seniority.

The correctness of this theory, so far as the genetic connection

of the tribe with the family is concerned, may be questioned. Instead of the former being an aggregation or expansion of the latter, it is highly probable that the primitive tribe is older than the family and the product of promiscuous sexual relations, and that families originated in a subsequent process of domestic differentiation. Polyandry and the custom of tracing descent exclusively in the female line would seem to point in this direction. The institution of the family, even in its polygamous form, presupposes a certain ethical element, which can hardly be predicated of primeval barbarism.

So, too, the most prominent feature in the social organization of the anthropoid apes and in all simian communities is the troop or tribe under the leadership of the most powerful male. A band of orang-outangs is doubtless an association of blood-relations, but there is no recognition of patriarchal authority as such and no evidence of distinct divisions into families. The community is a gregarious group of individuals joined in affinity, but not yet separated into single pairs with clearly recognized and jealously defended conjugal rights; and sovereignty is simply the assertion of superior force, although this constitution of the simian tribe does not entirely exclude the existence and exercise of moral qualities in the mutual relations of its members.

It is, however, a matter of no moment for the further evolution of society, whether, at the beginning, the family expanded into the tribe or was gradually differentiated out of it. The fact remains that the tribe was held together by the cement of consanguinity, and that the authority of the tribal head was derived primarily from the respect and reverence due to him as common progenitor, aided, of course, by his ability to enforce his claims to rulership in case an ambitious and rebellious Absalom should be disposed to question them. So strong and persistent is this sentiment that, even now, the number of a man's noble ancestors is supposed to entitle him, by the grace of God, to sovereignty, or to confer upon him some exceptional privilege and power.

With the transition from a nomadic to a sedentary social state, an important change takes place. No sooner has a people acquired fixed habitations and established permanent settlements than there arises the idea of ownership in the soil, and the chief of the tribe becomes the lord of the land. He is no longer merely the head of an organized body of roving men, but he also claims and exercises jurisdiction over a more or less definitely circumscribed district or domain and over all persons dwelling within its borders. Tribal sovereignty or chieftainship is thus superseded by territorial sovereignty or dominion, and with this transformation the state, in the modern sense of the term, really begins.

At this early stage, however, proprietorship in land was not

individual, but communal. It was the realization, to some extent, of the socialistic ideal of collective or governmental ownership of landed property, the return to which a modern school of reformers would fain persuade themselves and others to regard as a step in advance.

It is also interesting to note that this most important and epoch-making transition from pasturage to tillage was due to the initiative and activity of woman. Everywhere in the growth of society women have been the first agriculturists. While the men were leading the life of hunters or herdsmen, with frequent episodes of pillage and predatory warfare, women began to cultivate the soil and to rear domestic fowls, to spin and to weave, and to develop, in a rude way, various kinds of industry. This is the condition in which we still find all savage and semi-civilized tribes. Herodotus (vol. vi) says of the Thracians, "They regard tillage as the most degrading and pillage as the most honorable occupation." The savage looks upon all forms of manual labor, and especially husbandry, as ignoble, and therefore leaves such work to his squaw.

At first, her efforts in this direction were quite ignored and often thwarted by the sudden removal of the tribe to another place before she could reap the fruits of her toil. The little patch of ground which she had planted was deemed of small account, compared with the pleasures and products of the chase, and was frequently abandoned without hesitation before the meager harvest was ripe. For this reason barley was the earliest grain cultivated, because it is the hardiest of all grains and matures soonest. It was a long time before the fields tilled by women became of sufficient importance, as supplying means of subsistence, to keep the tribe settled for a whole season in one spot, or even to induce them to return thither in the autumn and remain there until the crop was gathered. This semi-nomadism was the first step toward a sedentary life and the starting point of a higher civilization, and woman was the chief agent in its accomplishment, although unconscious of the immense change which her humble efforts were effecting.

For a similar reason the weakest male members of the tribe were the first artificers and mechanical inventors. Men who were crippled or otherwise incapable of waging war and following the chase, if they had not been left to perish at their birth, remained at home and made hunting implements and weapons of war for their more vigorous and valorous tribesmen, and thus acquired skill in handicraft, sharpened their wits, and developed their inventive faculties. In mythology, the gods of the smithy, Hephæstus, Vulcan, and Veland, are represented as lame, and the experts in ores and workers in metals are dwarfs, gnomes, and creatures

of stunted growth. These physical peculiarities are not mere mythopœic whimseys and creations of the fancy, but correspond to real facts in the primitive history of the race, and point to the class of persons who were the earliest promoters of the arts.

The supersession of tribal by territorial sovereignty, although radical and permanent, was gradual and scarcely perceptible in its character, and did not begin to express itself in language till many centuries after the change had been fully accomplished. Mediæval and modern history furnish numerous illustrations of this process of social evolution and the manner of its operation. As Mr. Maine has remarked, there had been kings of England and of France long before John the Landless and Henry IV assumed respectively these official titles; although their predecessors had always been styled kings of the English and of the French. The Czar, who, while bearing sway as a territorial sovereign, preserves more than any other European ruler the peculiarities of a tribal chieftain, still calls himself Samodérshez, or Autocrat of all the Russias, and it was perfectly in keeping with the character and career of Napoleon I, as a *condottiere* on a colossal scale, that he took the title of "Emperor of the French." His interest was centered wholly in the army, which he loved and fostered in the same spirit that Tamerlane cherished his Mongolian hordes and Fra Diavolo his band of brigands. The King of Prussia bears the title of "German Emperor" (*Deutscher Kaiser*), not Emperor of Germany, since the latter would be inconsistent with the political existence and integrity of the other German states and a manifest usurpation of the rights and prerogatives (*Hoheitsrechte*) of the confederated princes and potentates. His imperial sovereignty is, therefore, essentially tribal; he is, so to speak, the chief of the German confederated monarchs, and exercises territorial sovereignty only as King of Prussia. There has been a long succession of Roman-German and German emperors, but never an Emperor of Germany.

A nomadic people, wandering from place to place, is not associated in any sense with the soil; the tribe remains the same, but not the territory it occupies. With the beginning of agriculture and sedentariness this relation is reversed. The conception of a nation, nowadays, implies fixed or at least well-defined geographical boundaries. Changes may take place in the character of the inhabitants and in the constitution of the government as the result of emigration and revolution; individuals and families may disappear and be superseded by others of a different stock, but the nation remains, as it were, *adscripta glebæ* within certain territorial limits and is not destroyed by any admixture of foreign with native elements in the population. Mr. Maine states this point very clearly and concisely when he says: "England was

once the country which Englishmen inhabited. Englishmen are now the people who inhabit England." An East Indian by blood may be an Englishman in the modern sense of the term as well as an Anglo-Saxon of purest lineage, however earnestly Lord Salisbury may deprecate the idea that a Hindu or any other "black man," even though he may be, like Dadabhoi Naoroji, a gentleman and a scholar, and the peer of the Tory premier himself in political wisdom and ability, should be sent to the British Parliament by an English constituency. It would seem, therefore, that, even at this late day, a man may be her British Majesty's first minister of state and yet entertain the notion, which prevailed in the days of Warren Hastings and still lingers among the subalterns of the colonial service, that an East Indian is a "nigger."

Nowhere is national feeling stronger and race feeling weaker than in the United States, where the negro, notwithstanding the prejudice growing out of his former condition of servitude, is as truly an American and as fully sensible of this fact as any scion of the Pilgrim fathers. It is unquestionable that the old Puritan stock is rapidly disappearing from New England, partly through natural extinction and partly through westward migration, and is being supplanted by Irish and Canadian French; but this circumstance does not blot New England from the map nor convert it into New Ireland or New France. On the contrary, the descendants of the Celtic immigrant are assimilated and transmuted by their environment and become New-Englanders. The consciousness of what might be called common territoriality tends not only to bind together and to blend diverse races into that "unity of a people" which constitutes a nation, but also to attenuate and to loosen the social and political unions, which are based upon common descent, and finally ruptures them altogether.

The aborigines of British America, who can not regard human beings otherwise than from a tribal point of view, still speak of the English as King George's men; but the inhabitants of Canada consider themselves Canadians irrespectively of their ancestral origin, and the same readiness to sink the claims of lineage when they conflict with territorial interests manifests itself even in the more recent colonies of Australia and New Zealand. Geographical contiguity proves, in such cases, stronger than genealogical connections; the old proverb, that blood is thicker than water, does not hold true of oceans.

The appeals that have been made in recent times to ethnic antipathies and ethnic sympathies for the purposes of political propagandism or the promotion of personal ambition are anachronistic attempts to resuscitate the tribal spirit under new forms and on a larger scale by a perverse and pseudo-scientific application of the results of comparative philology to public affairs. The hobby of

Napoleon III concerning the unity of the Latin nations, and the necessity of their closer confederation under the hegemony of France, was, like his Life of Cæsar, an act of historical self-justification, a desperate endeavor to explain his own *raison d'être*, and thus set up a temporary prop to a rickety and rootless dynasty.

Panslavism may continue, for a time, to please the imagination and to fire the zeal of a people so peculiarly subjected, in many respects, to primitive social conditions and so powerfully swayed by primitive ideas as are the Russians; but Germany has long since outgrown the swaddling-clout of Panteutonism, and no ranting of anti-Semitic agitators and men of that ilk about *ur-deutsch* and *rein-deutsch* can permanently affect the public mind or elicit a favorable response in legislative enactments.

There is no cry so foolish or pernicious that it will not find a ringing echo in the empty brain-pan of some fanatic, no whimsey so silly and absurd that it will not be caught up and preached as a new gospel of universal redemption by a few pamphleteering demagogues or ill-balanced apostles of reform. Impecunious owners of poorly furnished and tenantless garrets are only too ready to let them to the first vagrant that knocks at the door, however seedy his appearance and doubtful his repute. Even the anti-Semitic crusade, so far as it has succeeded in getting a hearing and making any headway among sensible persons, has done so by appealing to the liberal spirit of the age and representing itself as a protest against the tribal exclusiveness of Judaism.

The constitution of the aboriginal tribe as a compact body of kinsmen, animated by feelings of hostility toward all other tribes, necessitated the intermarriage of blood-relations. If, on account of scarcity of females, or for any other reason, a man desired to wed a woman of another tribe, instead of wooing her as a friend, he waylaid her as a foe, stunned her with a blow of his war-club, and carried her off as booty rather than bearing to his camp, where she served him henceforth, not so much as his companion and helpmate as his slave and beast of burden.

Even after this tribal exclusiveness and isolation had ceased and a certain amount of amicable intertribal intercourse had grown up, it was still deemed more virtuous or, as we would say, more patriotic for a man to marry his own kin than to take his wife or wives from an alien people. The tribal religion also lent its special sanction to such nuptials. Survivals of this sentiment are found in the ancient customs and in the sacred scriptures and traditions of many nations, especially in the Orient.

Thus, in the Avesta, a marriage of next of kin (*quaêtvadatha*) is declared to be particularly praiseworthy and well-pleasing to Ahuramazda, the Good Spirit (Visparad, iii, 18). This "kinship-union" is a prominent article of faith in the Mazdayasnian creed

(Yasna, xiii, 28); and in the Book of Ardâ Vîrâf (ii, 1, 2) Vîrâf is said to have had seven sisters, who were to him as wives (*chîgûn nêshman*), and this circumstance is adduced as evidence of his extraordinary piety. The connubial relations of this model of a religious man were both polygamous and incestuous.

Herodotus states (iii, 88) that Cambyses, the son and successor of Cyrus, was wedded to his own sister Atossa; and when, in the Hebrew story, Tamar rebukes Amnon for his guilty passion and tells him that "no such thing ought to be done in Israel," she refers solely to her brother's folly and wickedness in seeking a secret and illicit connection, and suggests that, if he will only speak to the king on the subject, there would be no obstacle to their union. That such marriages were common in the earlier history of the Jews is evident from the fact that Abram took to wife his half-sister Sarah, and this event is not recorded as an unusual occurrence.

Among the Persians this custom seems to have been confined, for the most part, to priests and kings, who constitute always and everywhere the two most conservative classes of society. Thus it came to be regarded as a mark of distinction or an enviable privilege, of which wealthy persons of inferior rank sometimes endeavored to avail themselves; but there is no evidence that it remained, within historical times, a law for the entire nation or was generally practiced by the people at large. The Magians continued to wive their sisters in conformity to ancient usage and holy tradition, for the same reason that stone knives and hatchets are used in sacrificial rites and fire for the altar is kindled by laboriously rubbing two sticks together long after these clumsy methods have been superseded in secular life by steel implements and lucifer matches.

A THEORY of Dr. Maurel, of the French marine, that the Khmers of Cambodia represent the leaders of the easternmost wave of migration of the Aryan or Indo-European stock, is noticed with approval by Dr. Brinton in Science. The ruins around Ang-kok decorated with bas-reliefs of scenes from the Ramayana give evidence of their having had an Aryan culture. They are supposed to have reached Cambodia about the third or fourth century of the Christian era, having apparently come from the delta of the Ganges across lower Burmah and Siam. Even at this time most of their followers may have been non-Aryan, and the leaders rarely of pure blood. In later generations they received a large infusion of Mongolian blood from the tribes they found in Cambodia. These conclusions, according to Dr. Brinton, are borne out by a close study of the existing population and of the history and archæology of the country.

DARWIN'S theory of the formation of coral reefs is not as near obsolete as some students have supposed. It had several friends in the discussion of the subject at the recent meeting of the British Association.

NIGHT HAWKS AND WHIP-POOR-WILLS.

By Dr. R. W. SHUFELDT.

THERE is hardly a season goes by that I am not asked, by some one more or less interested in our native birds, "What is the difference between a night hawk and a whip-poor-will?" Generally the belief is that these two very interesting forms are one and the same species; but this is by no means the case, and a full reply to the question leads us to the consideration of one of the most attractive groups in the entire range of our American avifauna. A number of years ago the writer made a very careful study of the representatives of this family as they occur in our country, and some of the more important facts as brought out by that research will be set forth in the present article. Those most familiar with the habits and anatomical structure of night hawks and whip-poor-wills and their allies place them in a suborder *Caprimulgi*, which primarily presents us with a family *Caprimulgidæ*, which family in the United States contains at least the four very distinctive genera *Antrostomus*, *Phalænoptilus*, *Nyctidromus*, and *Chordeiles*. To the first-named genus belong the true whip-poor-will (*A. vociferus*), together with Stephen's whip-poor-will, and the chuck-will's-widow of the Southern States, with others. *Phalænoptilus Nuttalli*, the interesting little poor-will of the Western States, is found in the second genus, while *Nyctidromus albicollis* is representative of the third. Finally, in *Chordeiles* we have the night hawks, as the common form, *C. virginianus*, as well as the Western night hawk, the Cuban night hawk, and the Texan night hawk (*C. texensis*).

To start with these it will be seen that our night hawk and our whip-poor-will belong to two very different genera of the *Caprimulgidæ*. Not only is this the case, but these two birds are in habits and in structure more widely separated from each other than is the whip-poor-will from any other genus of the family. Indeed, night hawks are quite aberrant types, while, as a matter of fact, none of our United States caprimulgine birds give us any hint of the extraordinary foreign representatives of this suborder, some of which will be referred to further on.

Upon comparing a night hawk with a whip-poor-will we find that, apart from the very well defined difference these birds exhibit in their internal structure and in the general tone and markings of their plumage, there are a few external striking features that ought to enable any person to distinguish one from the other at the most casual glance.

I refer especially to the long, conspicuous bristles projecting from about the mouth of the whip-poor-will, a character almost

entirely absent in the night hawk. Further, the tail of the former is very much rounded, with its four middle feathers like those of the back, the three outer ones, on either side, having their terminal halves *white*. In the night hawk the last-mentioned portions are *black*, and the form of the tail is very different. Our night hawk also has a distinctive white patch on the outer aspect of each wing, which is not present in the whip-poor-will. Again, the habits of these two birds are by no means similar. The whip-poor-will, with rare exceptions and under certain circumstances, is active and feeding from dark until daylight, and sleeps on the

FIG. 1.—THE NIGHT HAWK (*C. virginianus*), ♂. Drawn by the author and much reduced.

ground in the forest all day, the very reverse of this being the case with the night hawk. In some localities the latter is known by the name of the "bull bat," the first word undoubtedly having reference to the booming noise it emits during its plunging freaks through the air, in which it indulges while out abroad for food. Audubon and Wilson disagreed on the score as to how this noise was produced by the bird, the former claiming that it was performed by the wings, and the latter that it was "doubtless produced by the sudden expansion of his capacious mouth." I am inclined to the opinion of Audubon in this matter.

Among our native-born Americans I have never heard the name of goatsucker applied to our whip-poor-will, whereas that is a very common appellation for the species in many parts of Europe, where still all manner of crimes are accredited to this very harmless bird—that is, to its European congener. It is now, of course, an old story that long, long ago the goatherds of Italy and Greece, observing those birds at dusk flying around the

goats among their hilly pastures, and associating this fact with the known gaping mouth of a *Caprimulgus*, soon put the scandal on foot that they suck the teats of the animals, and thus rob them of the milk. That ancient philosopher Aristotle also believed the story, and enlarged upon the legend when he wrote that the "bird called *ægothelas* is a mountain bird, a little smaller than the cuckoo. It lays two or three eggs, and is of a slothful nature; flying upon the goats, it sucks them; they say when it has sucked the teat it becomes dry, and the goat becomes blind."

That charming naturalist White, of Selborne, did much toward breaking down this kind of rank superstition, informing us, as he has, that "the country people have a notion that the fern owl, or churn owl, or eve jay, which they also call a *puckeridge*, is very injurious to weanling calves, by inflicting, as it strikes at them, the fatal distemper known to cow-leeches by the name of *puckeridge*. Thus does this harmless, ill-fated bird fall under a double imputation which it by no means deserves: in Italy, of sucking the teats of goats, whence it is called the *Caprimulgus*, and with us, of communicating a deadly disorder to the cattle. But the truth of the matter is, the malady is occasioned by a dipterous insect, which lays its eggs along the chines of kine, where the maggots, when hatched, eat their way through the hide of the beast into the flesh, and grow to a very large size." Another name for this European goatsucker (*C. europæus*) is the "night-jar," and a popular writer on the natural history of the class thus accounts for its origin: "The jarring sound, which gives name to the bird, is uttered sometimes while flying, but usually when it is at rest; it seems to be produced in the same manner as the purring of a cat, and resembles it, though much louder. One of them, emitting this sound while sitting on the cross of a small church, communicated a sensible vibration to the whole building." (I doubt that that story will find many believers among us at the present day!)

If the accounts of the habits of such gentle creatures, as recorded by men, have passed, in time, through the various stages of traditional superstition, myth, and inaccuracy, to one of enlightenment, fact, and exactness, it has been none the less so with the various ideas of natural historians in the matter of their opinions as to the place occupied in the system by the *Caprimulgi*. One chapter is quite as full of interest as the other. More intelligent observation has cleared and is clearing away the mist that enshrouded the first, while this, combined with modern methods of scientific research, is rapidly rectifying the latter. Erroneous classification, in other words, is being corrected through the steady progress of our knowledge of the morphology or structure of the class *Aves*. From an evolutionary point of view such changing

taxonomical advances stand among the most engaging of all lessons to the philosophic ornithologist. External appearances, it has taught among other things, are by no means a safe guide to the orderly classification of any series of objects. Some old works upon my library shelves, formerly considered "standard" and "classic," contain many chapters in those premises which are highly instructive on this point. One of them now open before me places, according to its author, such utterly diverse bird-groups as the trogans, the kingfishers, the swifts, the goatsuckers, and the humming birds, all among the *Passeres*. Linnæus and a number of his successors had no better appreciation of the truth, for the scientific light shed over such fields was to them still quite dim. He placed, with all confidence, the *Caprimulgi* in his order *Passeres*. Later, this created the usual intelligent, incredulous smile of the scientific taxonomer, and in the next epoch we find in their writings an "order" created to contain, among other types, the swallows, the swifts, and the goatsuckers! Then, too, think of Huxley, who as late as 1867, upon osteological grounds made a division *Cypselomorphæ*, to which he restricted the swifts, the humming birds, and the goatsuckers. A decision of that kind coming from such an influential quarter has carried with it the weight of conviction to the minds of our most recent ornithological writers and systematists. And we find Elliott Coues, in his last revised edition (1890) of his Key to North American Birds, still adhering to the old order *Picariæ*, in the first group of which, the *Cypseliformes*, he places the swifts (*Cypselidæ*), the goatsuckers (*Caprimulgidæ*), and the humming birds (*Trochilidæ*). But a far more unnatural grouping is seen in the Manual of North American Birds, by Mr. Robert Ridgway, where an order *Macrochires* is retained to contain the goatsuckers, the swifts, and the humming birds, and in this he is followed by the check list of the American Ornithologists' Union. What special kinship the systematist sees between a humming bird and a whip-poor-will, the morphologist in these days certainly fails to appreciate. Anatomically the writer has examined in great detail several species of different genera of both humming birds and goatsuckers, as he also has many swifts and swallows, and is of the opinion that the *Caprimulgi* are most nearly related to the owls, while the swifts are but profoundly modified swallows. To thoroughly appreciate such affinities it is necessary that we should have before us the so-called "outliers" of the various groups just named.

Representatives of the suborder of birds, United States species of which we are here considering, are found in many parts of the world, though they appear to be entirely absent from the avifaunæ of Polynesia and New Zealand. In South America, in Asia, in Africa, and in Australia we meet with goatsuckers of the most

varied kinds, both in the matter of form and plumage. One of the most evident types exemplifying the kinship between the *Caprimulgi* and the owls is the extraordinary species found in the caves of Caripe in South America and in Trinidad. This is the well-known "oil bird," the *Steatornis caripensis* of science, and also called the *guacharo* by the natives, who enter every season the caves where it breeds to collect the young. This is done to obtain the grease by trying out their fat-laden bodies, and thus the species has a certain economical importance. In its structure *Steatornis* is much like some owls, and its two to four white eggs, laid

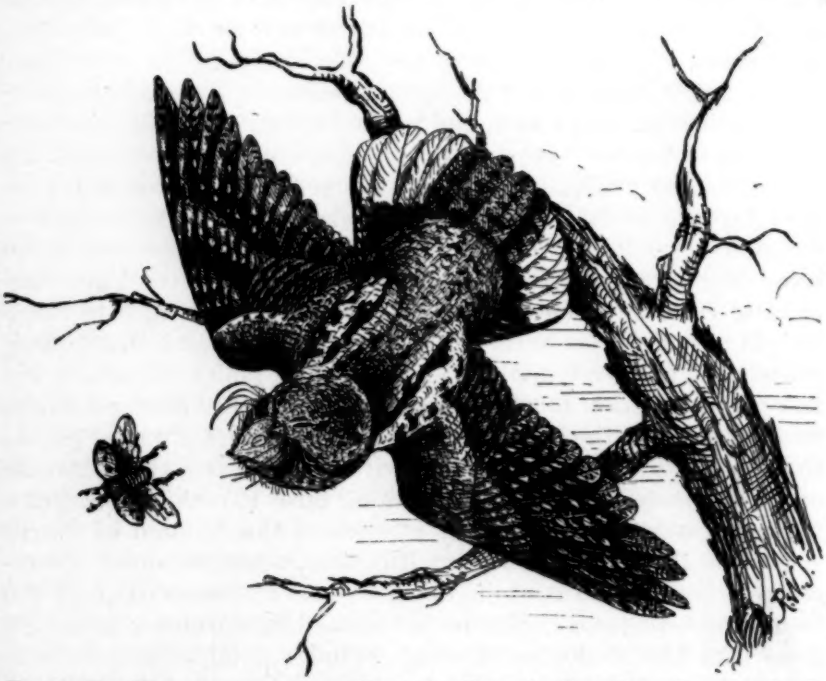

FIG. 2.—THE WHIP-POOR-WILL (*A. vociferus*), ♂. Drawn by the author and much reduced.

in a nest built by the bird of clay, closely resemble the eggs of certain birds of that group. Likewise it is nocturnal in habit, and markedly differs from the average goatsucker inasmuch as it feeds upon fruit and certain oily nuts. Structurally it has been examined with some care by the British anatomist Garrod, who fully appreciated its relation to the owls. Well it may be said that most owls have long legs which they can use to full advantage, which our night hawks and whip-poor-wills do not possess, those members being so short in them that they can only shuffle over the ground with difficulty. Yes, but there is also a Central and South American species of goatsucker, with legs so long that it can run upon *terra firma* with all the swiftness and ease of one of

our peculiar little burrowing owls of the Western prairies (*Speotyto*). Again, it is said that such owls as our screech owls (*Megascops*) exhibit a dichromatism of plumage, being "rufous" in one and, when adult, "gray" in the other, and that they have "ear tufts" or plumicorns ornamenting their heads. Here it is interesting to know that in the Malay Archipelago and in China we meet with the goatsucker *Lyncornis*, which is also characterized by the possession of "aural tufts" and a dichromatism of plumage —the same species having been taken in both a rufous and a gray one. And so we might pass from one species to another, gathering one habit here, and another point in anatomical structure there, until the most skeptical person in the world would at last be convinced that the two groups (*Caprimulgi* and *Striges*) were in some strange way related.

Plumicorns are also possessed by the remarkable Indian caprimulgine bird *Batrachostomus*, a species which also occurs in the Malay Archipelago, and still other very curious genera of other parts are the *Nyctibius* and *Ægotheles* and *Podargus; Podargus cuvieri* being fully three times as large as any known North American species of goatsucker, being found in the island of Tasmania. where its peculiar cry has caused it to receive the name of "morepork" by the colonists of that distant quarter of the globe. But for the greatest oddities among these birds, especially in the matter of plumage, we must turn to Africa, and that paradise for the explorer, Madagascar. For instance, the *Macrodipteryx* of Africa has the *ninth* primary feather of either wing developed to a pennant-like length, and when the bird is seen during flight these appendages float out in the most striking manner; being still more peculiar in an allied species where the shaft of these elongated feathers is naked, and it is only at their extremities that a spatulate form of the web is retained. Madagascaran species exist that even have still more remarkably developed wing feathers, while in the South American *Psalurus*, again, it is the lateral tail feathers that are greatly lengthened.

In concluding this brief paper I would invite attention to the fact that we find the family of goatsuckers immediately following the family of owls in Audubon's Birds of America, and of the former he observes that they are "very nearly allied in some respects to the owls"; and I am strongly inclined to the belief that that "careful dissector of birds," the "Scotch anatomist" William Macgillivray, had much to do with bringing the mind of our distinguished Franco-American ornithologist to that opinion.

RECENT RAILROAD DISASTERS.

By LAFAYETTE C. LOOMIS.

THE frequency and the frightful fatality of recent railroad disasters have come to be most appalling. Among the more prominent causes put forth in explanation or in extenuation is that of the overtaxed and exhausted condition of the trainmen. This excuse, while reluctantly accepted in part by the public, is little better, however, than none at all, as, so far as it is valid, it simply transfers the responsibility from the trainmen to the officers, and substitutes criminal mismanagement for criminal carelessness.

But this statement by no means meets the case.

Among some of the most sanguinary that come to my mind at this moment—the calamity of the Wabash, the Chester Bridge, the two on Long Island, and not long since at Yonkers, at Germantown, and near Dedham—with none of these had fatigue anything whatever to do. The men responsible for these calamities were comparatively or altogether fresh.

That the men forgot, or were careless, or inattentive, or neglectful, is true; but that in these and in many other cases, the men were overtaxed and exhausted is not true. Some other and more comprehensive cause of these oft-recurring calamities must be sought.

The science of railroad transportation, to whatever extent it has advanced, has been almost wholly the result of experiment rather than of theory. From first to last the theories, for the most part, have proved very wide of the actual results. Nor is this a matter of surprise when we consider what a revolution the locomotive wrought among mankind.

As the successor of the stagecoach, steam travel was inaugurated upon the general principles which that earlier mode of travel had evolved from long years of experience. The steam road in all its multitudinous appendages was cast to meet certain supposed requirements as to speed and volume of traffic. The roadbed, ties, rails, engines, and cars had all been calculated to meet a certain assumed pressure, strain, wear and tear. Such, however, was the almost immediate demand for larger facilities, that hardly had the various appliances of the road become adjusted to each other and their new conditions, before the extension and enlargement of the road in all its capacities had become imperative.

It was not difficult to construct an engine with greater steam capacity, and hence greater power and speed; but what a series of calamities followed! The roadbed, the ties, the rails, the wheels, were all disproportionate and inadequate.

Who that recalls the railroad conditions of forty years ago does not remember the constant succession of misfortunes chargeable to the single track, the imperfect bed, to broken rails and wheels, and a hundred other imperfections in machinery and the necessary appliances?

All these mishaps and catastrophes were a part of the new conditions men were seeking to master.

Not only was the whole scheme new to mankind, but the burden at once thrown upon it was utterly beyond its design or its capabilities. No one was more keenly alive to the inadequacy of these first plans to meet the public want, than were the railroad men themselves. But an enterprise involving millions of dollars in a definite, precalculated system is not like a garment that can be thrown aside and replaced by another at pleasure.

However desirable, the abandonment of existing conditions and the adoption of others must necessarily be slow in enterprises of such magnitude and expenditure.

Nevertheless, during those forty years, such was the mastery of general principles and detail in the construction of the road and the rolling stock, and such the perfect adaptation of part to part, that to-day failure—i. e., so-called accidents—pertaining to either of these particulars is rare.

During these years experience met each weakness as it became apparent, until now a first-class road runs thrice the weight at thrice the speed with almost entire immunity from casualty from these causes. The "accidents" of the earlier years have been well-nigh eliminated from our modern train.

But "accidents" yet remain no less frequent than in those days of inexperience. This undreamed-of accession of power and speed has also brought a larger range of liability, new conditions, and new perils.

In the earlier mishaps the fault was found to exist mainly in our want of knowledge of the innate strength of the materials used—a fault inseparable from our inexperience. In our later "accidents" the fault has not been found in the material nor in the structure. Quite otherwise.

In that frightful Yonkers calamity the fault was found to be in "the man." In the two Long Island wrecks, in the Dedham, the Chester Bridge, in the Wabash, the Germantown, and so on almost without variation, the fault has been in "the man," not in the road.

That is, in the development of these immense steam forces we appear to have reached a point where the brain force undertaking the guidance and control has become the fault-bearing element and the more fruitful cause of calamity. And so manifest has this preponderance become, that it calls for the most serious consideration.

In general terms, the brain force in our modern rapid transit, seems incommensurate with the demands laid upon it.

A fast Atlantic steamer has ordinarily, for fair weather, three or more men on watch, and two officers on the bridge; and in thick weather often not less than ten or twelve, whose sole business it is to guard the ship against outside contingencies.

We start out an express at four times the speed in equally thick weather, under the care and direction of a single man—in a few cases, perhaps, with an assistant.

Let us note the ordinary duties of this man with hundreds of lives in his keeping, plunging into the darkness, storm, snow, and fog at a speed of sixty to ninety miles an hour.

He is supposed to stand with his hand upon the throttle, looking to scan every rod of his fast-flying track, to note every crossing, every approaching vehicle, every straying animal, to observe every signal and every switch, while there are beside him in his cab from fifty to seventy-five levers, valves, cocks, gauges, handles, and what not, which he is expected to apply instantly as the exigency may arise, as danger may spring into view, or calamity confront.

It is said that Wellington, at a critical moment of Waterloo, when a message was brought to him that a certain battalion was without ammunition, failed to respond to the call. Afterward, referring to his failure and to the disaster which resulted to the battalion, he said: "It is true; but no man can think of everything."

In the heat and stress of battle a man may be pardoned an inability to recollect, even at the cost of human life; but a system of business that, every hour of the day and night, intrusts the lives and safety of the public to the care and protection of a brain overburdened and distracted, like that of a locomotive engineer, is open to the gravest criticism.

Nor is it in the duties of the engineer only that this peril abides. The Yonkers disaster, and one of those on Long Island, were from the rear; the Wabash and the Germantown from the siding. It thus appears that the demands of the modern train are insufficiently met by the intellectual guiding force at all points—front, rear, and on the sides.

The New York World in a recent article approached this question under the title of "A Psychological Puzzle." Referring to the Wabash switchman, the article says: "What made that brakeman turn the switch and let the express train plunge into the waiting freight? The accounts all agree that Thompson was a man of experience, a trusted man, and of more than ordinary intelligence. He had frequently stopped at the same siding to let the same train go by. . . . Why did he do it? Not to wreck the

train and kill the passengers. His mind wandered for a moment, he forgot his duty, and before he came to himself the mischief was done. Carelessness is hardly a complete explanation, nor is forgetfulness. . . . Does our mental machinery suddenly fail us at times?"

The continuity of the track is ordinarily broken by a like switch every few miles. An hour's ride takes the train over a dozen such breaks, any one of which misplaced means a horror like that of the Wabash. The rear guard may at any moment, from some irregularity to his train, be called upon to hasten back with the danger signal against an on-rushing second section or a close-following train. Should he stumble amid the storm, be blinded by the snow, or should the wind extinguish his light, or should he, like Thompson, fail from some unaccountable cause, a second Yonkers would follow.

Whether the explanation suggested by the World be the true one or not, one thing is very evident in the light of our modern experience, and that is, that such responsibilities as now attach to the trainman of a modern express, whether it be engineman, switchman, or brakeman, ought not to be longer intrusted to the protection of any single mind, however faithful, however conscientious. Were the human mind and body perfect as a machine, faultless in its workings, and with no liability to irregularity, failure, or lapse, we might be so justified. But, not to speak of the body, no mental organization is perfect. Frailty is a part of man's inheritance. Against that frailty, against that fatal moment, we have now no protection whatever. We are abandoned by our sole guardian, by the only divinity that stands over us, and we are left to a horrible death or to the tortures of hell. It is idle to say these men are careless, that they are regardless of duty. They are as faithful and as trustworthy as would be any other men put in their places—as faithful as our human nature permits.

It simply appears that we have been attempting to force from our human organization a degree of exactitude in the operations of the mind which the brain refuses to yield. And in view of the sanguinary record of the few past years, directly at the hands of the men in charge, we may well question the wisdom of a longer trial. It no longer remains an uncertainty where the weakness of our present system lies, where the danger abides. That the brain power of a modern express is disproportionate to the requirements, admits no further question. Safety in land travel, no less than in ocean travel, demands a duplication of the officers in charge. Whether it be engineman, rear guard, brakeman, switchman, or whoever undertakes to stand between the passenger and the multiplied dangers of the road, there should be a first and a second officer, that, in any and every emergency, whether through care-

lessness, forgetfulness, or lapse of conscious thought, the duties of that post should be sustained.

Does any one for a moment suppose that, if there had been a second officer whose business it was to inspect that Wabash switch and see and certify that it was properly set, or that if the Yonkers brakeman had been followed by a second signal light fifty yards in the rear, either of those catastrophes would have occurred, or any of these recent rear-end and siding calamities?

When, ordinarily, human life is taken, the whole machinery of the criminal law is exercised to bring the offender to justice. But here a score of persons are put to death, or to a torture the like of which exists not elsewhere in any portion of our globe, either civilized or savage—torn, mangled, crushed, scalded, burned—and it is held excusable as an "unavoidable accident."

To say that these things are a necessary part of the progress of mankind is a libel on civilization. To declare them unavoidable accidents is, for the most part, to assert that which is not true—to attempt a justification through what we know to be false. Accidents they are not. They are simply criminal maladministration.

When one's life is sacrificed, or when one is maimed for the remainder of his miserable years, it is of little import to the sufferer or to his family whether it be the result of criminal intent or of criminal neglect. The shade of difference is not so very clear between life needlessly taken and life purposely taken.

Since the foregoing was written, the death-angel has pursued his appalling railway harvest with unabated fury, seventy-seven deaths and one hundred and eighty-four mangled in thirty days, being the record for the United States, so far as heard.

From the general facts as given in the public prints, these calamities, like those above referred to, and like the most of those now occurring, appear to be attributable to "the men" and not to "the road." There have also appeared in the public press some explanatory or apologetic statements from officers of several roads, some of which are worthy of attention as expressing the views of the officials into whose care the public intrusts its welfare; none of which, however, give it any assurance of any greater degree of safety.

An officer of the New York, Lake Erie, and Western is reported as saying, "I can not explain the unusual number of accidents just now"; adding, however, "the train-dispatcher's duties have become very much more exacting." This means, if it is intended to mean anything, that the fault lies in the train-dispatcher, not in the road or machinery.

One of the superintendents of the New York Central says: "Railroad accidents are like epidemics; they can no more be fore-

told or arrested (prevented ?). . . . When a train is on a double-tracked road, the danger is reduced, I may say, one hundred per cent."

The first statement of this superintendent, if spoken hastily, without thought, may be excused as a careless utterance; but as a deliberate opinion that this railroad slaughter is not preventable, and that there is nothing left for the public but to submit to its continuance, it is simply atrocious and worthy of a savage of the Congo.

Such a statement from a railroad official, into whose hands we must perforce place our lives and those of our wives and children, is ample ground for impeachment. It makes one's blood boil.

It is to put up a sign over every station entrance on the New York Central: "Slaughter permitted here. Accidents can not be prevented." Yet, in the next breath, this superintendent adds "Double-tracking the road reduces the accidents one hundred per cent" (*sic*).

It seems, then, that one hundred per cent of the accidents were not only preventable, but that on the New York Central they had been so prevented. When the road was the source of danger, the weakness was met and overcome by re-enforcing the road. Now that the weakness is found to reside in the men, the slaughter of to-day makes an imperative demand for an augmentation of the forces, at the present moment, so inadequately and disastrously attempting control.

EVOLUTION IN PROFESSOR HUXLEY.

By St. GEORGE MIVART, Ph. D., F. R. S.

So many adventures of gods and heroes, alternately defeated and restored, with so many other myths of earlier religions, merely (we are told) describe, in figurative language, the simplest physical phenomena, that most of us now expect to find "the dawn," or "sunset," latent in every one newly met with.

Our fairy tales also may be similarly treated, but most of them will also serve to represent, under an allegory, notable events or circumstances of human life.

The history of that gentle animal, beloved of our childhood, the White Cat—an enchanted princess, doomed to bear that feline form till freed, through the loss of head and tail, by the sharp sword of her royal lover—admits such an allegorical interpretation.

Some learned professor might tell us its real purpose was to show that pain and loss can serve to restore a noble soul, deformed by evil influences. He might also enlarge upon the text, describing how the spellbound maid herself demands the blow, and point

out we ought to learn from this that our higher aspirations should bid us brave death itself if, by a voluntary martyrdom only, we can so hasten on the triumph of "the good, the beautiful, and the true."

But this transformed princess, as also the Sleeping Beauty, Riquet with the Tuft, and Beauty and the Beast, all may alike serve to image forth an aspect of the Cosmos which is particularly interesting to us to-day. They all indicate, by some astonishing transformation, how every one and everything is affected through new conditions of environment, how change pervades the universe, and how all of us must undergo a process of evolution, though not, by any means, one in the entirely beneficent direction, nor with the rapidity these fairy tales indicate. But rapidity is essentially a relative term; and so the swift sword-stroke of the one prince or the awakening kiss of the other can quite well symbolize the slow, as well as rapid, processes of the natural world.

That universal and unceasing process of change which goes on throughout the Cosmos must affect the mind as well as the body of every one of us. Nor could a reasonable man wish that it were altogether otherwise with him, since "to cease to change is to cease to live." But we naturally shrink from decay, and should do so from mental degradation, while evolution (as above said, and as every one knows) is not universally or necessarily beneficent. Among the many evils around us (the existence of which none but an irrational optimist will deny) are the results of evolution in certain minds—minds which, in the battle of life, have become more and more morally degraded and intellectually darkened, and so continue till the end.

We might, in truth, put forward as an argument in favor of a brute element in our being, the fact that increasing years so often fail, in men as in monkeys, to produce any visible increase of "sweetness and light." On the other hand, we are most of us fortunate enough to know men in whom long life has served to ripen the most precious mental fruits.

It is the process of evolution in the mind which should above all things interest us. The great cosmic process considered as evolving suns and planets and bringing forth vegetal and sentient life is of course a wonderful and admirable process. Yet it is nothing to the formation of a single self-conscious being. So far as our knowledge extends, it is true that

> "In Nature there is nothing great but man:
> In man there is nothing great but mind."

Phases in the development of one human intelligence must therefore form a really nobler object of study than that of myriads of stellar orbs devoid of intellect.

But if mental processes should be thus interesting, *a fortiori* should they be so if they are those of a great expositor and apostle of the doctrine of evolution itself. Above all ought they to concern us if that expositor exercises great influence, is looked up to by multitudes of disciples, and has been in the habit of coupling with his expositions, precepts respecting matters which most of us think extremely important.

These considerations lead me to think that the time has come for some one to say a few words with respect to the process of evolution which seems to have taken place in the mind of Prof. Huxley. I venture, therefore, on the following observations.

Though it can not be affirmed that any sharp edge of criticism has transformed him as the sword-blade transformed the enchanted princess, nevertheless some changes of aspect are, I think, to be detected in certain of Prof. Huxley's recent utterances.

To these I desire to call attention, since they appear to justify the hope that ripened experience and mature reflection have called forth statements which, if (as is possible) they do not denote any consciously changed views, must surely, at the least, indicate their latent presence.

There are two matters with respect to his last publication* especially noteworthy: (1) The first of these concerns our ethical perceptions; the second (2) relates to the nature of man as contrasted with that of other organisms.

Besides these matters, I would also refer to certain corollaries which, in my humble judgment, result from the views he has put forward with respect to humanity and ethics.

The present inquiry is no hostile one, but is made in a spirit of sympathy—such as a decade of pleasant memories should occasion. Long ago,† and also recently,‡ I said, "No one, I believe, has a greater regard for Prof. Huxley than I have, and no one is more convinced than I am of the uprightness of his intentions and his hearty sympathy with self-denying virtue."

If I may have the great satisfaction of finding that, as to ethical perceptions, he has approximated to the standpoint I long ago advocated, that satisfaction will be free from any taint of triumph. I am far too keenly aware of my own past difficulties to wonder at another intellect having been obscured by clouds which so long overshadowed my own. Indeed, the clearing away of those obscurities is indirectly due to Prof. Huxley himself. Such is the case, since it was in that lecture room in Jermyn Street—where, owing to his kindness no less than his ability, I gained much of the biological knowledge I possess—I made the

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* The Romanes Lecture, 1893. † Contemporary Review (January, 1872), p. 196.
‡ Essays and Criticisms (Osgood, McIlvaine & Co.), ii, 101.

acquaintance of a dear and valued friend, whose acute intellect first taught me to fully understand in what the essence of "goodness" consists, as his virtue led me to appreciate its active exercise. But my enlightenment ultimately resulted in controversy; and, in order that my readers may be able to judge what signs of ascensive evolution Prof. Huxley has lately shown, I must briefly refer to a passage of arms which took place between us one-and-twenty years ago.

I had, in a little book, then recently published,* contended that the process of "natural selection" could never have evolved our ethical perceptions and our clear intellectual idea of "duty" as distinct from mere feelings of "sympathy," "fear," etc. I said:

These two ideas, the "right" and the "useful," being so distinct here and now, a great difficulty meets us with regard to their origin from some common source. For the distinction between the "right" and the "useful" is so fundamental and essential that not only does the idea of benefit not enter into the idea of duty, but we see that the very fact of an act *not* being beneficial to us makes it the more praiseworthy, while gain tends to diminish the merit of an action. Yet this idea, "right," thus excluding, as it does, all reference to utility or pleasure, has nevertheless to be constructed and evolved from utility and pleasure, and ultimately from pleasurable sensations, if we are to accept pure Darwinism: if we are to accept, that is, the evolution of man's psychical nature and highest powers by the exclusive action of "natural selection" from such faculties as are possessed by brutes; in other words, if we are to believe that the conceptions of the highest human morality arose through minute and fortuitous variations of brutal desires and appetites in all conceivable directions.

It is here contended, on the other hand, that no conservation of any such variations could ever have given rise to the faintest beginning of any such moral perceptions; that by "natural selection" alone the maxim *fiat justitia, ruat cælum*, could not have been excogitated, still less have found a widespread acceptance; that it is impotent to suggest even an approach toward an explanation of the *first beginning* of the idea of "right." It need hardly be remarked that acts may be distinguished, not only as pleasurable, useful, or beautiful, but also as good in two different senses: (1) *Materially* moral acts; and (2) acts which are *formally* moral. The first are acts good in themselves, *as acts*, apart from any intention of the agent, which may or may not have been directed toward "right." The second are acts which are good, not only in themselves, as acts, but also in the deliberate *intention* of the agent who recognizes his actions as being "right." Thus acts may be *materially* moral or immoral in a very high degree without being in the least *formally* so. For example, a person may tend and minister to a sick man with scrupulous care and exactness, having in view all the time nothing but the future reception of a good legacy. Another may, in the dark, shoot his father, taking him to be an assassin, and so commit what is *materially* an act of parricide, though *formally* it is only an act of self-defense or more or less culpable rashness. A woman may innocently, because ignorantly, marry a married man, and so commit a *material* act of adultery. She may discover the facts and persist, and so make her act *formal* also.

* The Genesis of Species (Macmillan & Co.), 1871, second edition, p. 219.

Actions of brutes, such as those of the bee, the ant, or the beaver, however materially good as regards their relation to the community to which such animals belong, are absolutely destitute of the most incipient degree of real—i. e., formal—"goodness," because unaccompanied by mental acts of conscious will directed toward the fulfillment of duty.

By the examples thus given, it was surely plain that I represented the *formally* moral character of an act to reside in the *intention* wherewith it was performed, as distinguished from mere good results, and also in the goodness of that intention. This was made still plainer in my Quarterly article* on The Descent of Man. Therein, to guard against the absurdity of supposing I meant that it was necessary, in order that an action should be good, for its goodness to be deliberately thought of and reflected on, I said:

An action which has ceased to be directly or indirectly deliberate has ceased to be moral as a distinct act, but it is moral as the continuation of those preceding deliberate acts through which the good habit was originally formed, and the rapidity with which the will is directed in the case supposed may indicate the number and constancy of antecedent meritorious volitions.

Prof. Huxley reviewed† my book and this Quarterly article, simultaneously and at much length, in an exceedingly interesting paper entitled Mr. Darwin's Critics, which I strongly advise those interested in the question to read before reading my reply to it. Therein, entirely siding with Mr. Darwin, he did not hesitate to say‡ (as to my distinction between "material" and "formal" morality):

For myself, I utterly reject it, inasmuch as the logical consequence of the adoption of any such principle is the denial of all moral value to sympathy and affection. According to Mr. Mivart's axiom, the man who, seeing another struggling in the water, leaps in at the risk of his own life to save him, does that which is "destitute of the most incipient degree of real goodness," unless, as he strips off his coat he, says to himself, "Now, mind, I am going to do this because it is my duty, and for no other reason"; and the most beautiful character to which humanity can attain, that of the man who does good without thinking about it, because he loves justice and mercy and is repelled by evil, has no claim on our moral approbation. The denial that a man acts morally because he does not think whether he does so or not may be put upon the same footing as the denial of the title of an arithmetician to a calculating boy, because he did not know how he worked out his sums.

I wondered, and I wonder still, how Prof. Huxley could have written this, he having before his eyes the passage of mine, just above cited, from the article of the Quarterly Review which he was criticising!

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* See Quarterly Review, July, 1871, p. 82; and also my Essays and Criticisms, 1892, ii, 49.

† See The Contemporary Review for 1871; and also his Critiques and Addresses, 1873, p. 251.

‡ Critiques and Addresses, p. 288.

However, my point now is simply to remark how far the right honorable professor then was from assigning "motive" as the one essential character of a good action. Most certainly, neither sympathy nor affection is always moral, and as to unconscious beneficent actions, I remarked, and repeat, How can a man "love justice" if he can not distinguish it from injustice? Can he appreciate "mercy" without knowing it?

A calculating boy who does not understand arithmetic can not be properly termed an arithmetician, whatever his automatic power of rendering solutions may be. But my opponent not only took the opposite view to this, but went still further; for he wrote: *

> If a machine produces the effects of reasoning, I see no more ground for denying to it the reasoning power because it is unconscious, than I see for refusing to Mr. Babbage's engine the title of a calculating machine on the same grounds.

It would be hardly possible to imagine a better illustration of the absence of discrimination between what is merely "material" and what "formal" in reasoning; and this defect runs singularly parallel with the absence of a like discrimination—the discrimination as to motives—in the domain of ethics on the part of Prof. Huxley in 1871.

Finally, so complete was then his identification of "duty" with "pleasure," that, when attempting to assume, for the moment, the position of an "absolute moralist," he wrote: †

> To do your duty is to earn the approbation of your conscience or moral sense; to fail in your duty is to feel its disapprobation, as we all say. Now is approbation a pleasure or a pain? Surely a pleasure. And is disapprobation a pleasure or a pain? Surely a pain. Consequently all that is really meant by the absolute moralists is that there is, in the very nature of man, something which enables him to be conscious of those particular pleasures and pains.

Inasmuch, therefore, as Prof. Huxley would then have said that the proper object of life is to do one's duty, he must likewise have thereby meant that its object also was to *escape from the pain and sorrow* consequent on its non-fulfillment. Such is the necessary consequence of identifying an ethical perception (a matter of intellect) with a "feeling."

But it is not a fact that every perception of duty performed, and recognized as such, is necessarily pleasurable; nor every consciousness of duty similarly violated, a painful experience.

In a perfect nature, of course, moral sentiments will always harmonize with ethical perceptions. But who is perfect? To do right is often a labor and a sorrow, and it is certainly not less meritorious on that account.

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* *Loc. cit.*, p. 281. † P. 289.

But, unhappily, men sometimes take pleasure in acts which their conscience disapproves, and enjoy them the more on such very account. "I'm a sad dog, I am, no mistake about that!" has been said, now and again, with a pleasurable chuckle of immoral self-consciousness, by men not by any means the worst of sinners.

Real merit depends exclusively on motives, and thus one and the same act may be moral or immoral, according to the direction taken by the will in performing it—as in the instances above given of the sick nurse and the woman materially an adulteress.

But this ethical distinction between acts *formally* and only *materially* good—the distinction of motive and consequent merit or guilt—is the most important distinction which it is possible for us to draw in the whole domain of human thought, from elementary arithmetic up to the highest regions of philosophy.

The reader will readily understand then my satisfaction when, on perusing the right honorable professor's recent lecture, I read as follows:*

> Civilization could not advance far without the establishment of a capital distinction between the case of involuntary and that of willful misdeed; between a merely wrong action and a guilty one. And, with increasing refinement of moral appreciation, the problem of desert, which arises out of this distinction, acquired more and more theoretical and practical importance. . . . The idea of justice thus underwent a gradual sublimation from punishment and reward according to acts, to punishment and reward according to desert; or, in other words, according to motive. Righteousness—that is, action from right motive—not only became synonymous with justice, but the positive constituent of innocence and the very heart of goodness.

The position of the absolute moralist could not be better expressed than in those admirable words: The "very heart of goodness" lies in action due to right motives and good will.

I add the words "good will" because, with the attribution of guilt or merit to actions according to the motives of the doer of them, a certain freedom must also be attributed to the will itself. Moral blame or approbation can not (as the universal custom of mankind shows) be attributed to any being destitute of all power of choice or of any control whatever over the actions he performs. Prof. Huxley will not deny that "our volition counts for something as a condition of the course of events."

An act of free will is no uncaused event. Its cause is the spontaneous self-determination of him who freely acts.

But some noble words in the recent Oxford lecture specially merit notice as containing in them an energetic repudiation of the utilitary theory of morals. They are:† "We should cast

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* [November Popular Science Monthly, pp. 24, 25.]

† [December Monthly, p. 191.]

aside the notion that the escape from pain and sorrow is the proper object of life."

I will now pass to the second of the two processes of evolution which his recent writings seem to indicate as having taken place in the mind of Prof. Huxley.

He and I worked simultaneously and harmoniously to show how much less the human body differs from that of an ape, than does that of an ape from any other animal.

In his work on Man's Place in Nature (1863), he diverged from Cuvier and followed Linnæus by including man in one order —Primates—with the apes and lemurs. In the first scientific paper I ever published,* I went yet further and reduced man (anatomically considered) to the rank of a section of a suborder of the Primates, for which section I first proposed the term "Anthropoidea."

But while the professor took the position of an entire sympathizer with and supporter of Mr. Darwin's views as to man's origin, I have ever maintained that, in spite of the closeness of bodily resemblance, the psychical gulf between him and them constitutes a profound difference not merely of degree, but an absolute distinction of kind—one involving a difference as to origin.

The position I at once assumed, which I have unfalteringly upheld, and now maintain more confidently than ever, is that no mere process of evolutionary natural selection, no cosmic process, could ever have produced from irrational Nature a being "looking before and after"—a being who could say either "this must be absolute truth," or "such is my duty and I will, or will not, do it." It was with great satisfaction, therefore, that I perused some of the passages on this subject in the recent Romanes lecture.

Therein, after having affirmed † that the mere animal man had attained his position by the cosmic process—a view I had supported ‡ in 1871—the lecturer makes the following statement: *

> The practice of that which is ethically best—what we call goodness or virtue —involves a course of conduct which, in all respects, is opposed to that which leads to success in the cosmic struggle for existence. In place of ruthless self-assertion it demands self-restraint; in place of thrusting aside, or treading down, all competitors, it requires that the individual shall not merely respect but shall help his fellows; its influence is directed, not so much to the survival of the fittest, as to the fitting as many as possible to survive. It repudiates the gladiatorial theory of existence.

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* Proceedings of the Zoölogical Society, 1864, p. 634. See also The Philosophical Transactions, 1867, p. 300.

† [November Monthly, p. 21.]

‡ See The Genesis of Species, p. 325.

* [December Monthly, p. 189.]

We read also:

Social progress means a checking of the cosmic process at every step, and the substitution for it of another, which may be called the ethical process. It depends (he tells us on the next page) not on imitating the cosmic process, still less in running away from it, but in combating it.

It is yet further said: *

The history of civilization details the steps by which men have succeeded in building up an artificial world within the Cosmos. Fragile reed as he may be, man, as Pascal says, is a thinking reed: there lies within him a fund of energy, operating intelligently, and so far akin to that which pervades the universe that it is competent to influence and modify the cosmic process.

I have always maintained that the cosmic process, since it often favors the ill-doer more than the virtuous man, could never by any possibility have evolved the ethical ideal.

Prof. Huxley now bears the most satisfactory witness to this truth, saying: †

The thief and the murderer follow Nature just as much as the philanthropist. Cosmic evolution may teach us how the good and evil tendencies of man may have come about; but, in itself, it is *incompetent to furnish any better reason why what we call good is preferable to what we call evil than we had before.*

Just so! It would be difficult to declare more emphatically that ethics could never have formed part and parcel of the general process of evolution.

But with that change, whatever it may have been, which first introduced into this planet an intellectual, and therefore ethical, nature, it is no wonder that consequences thence resulted destructive of antecedent harmonies.

Many persons deplore the ravages which the one intellectual animal (man) has effected on the fair face of Nature. As a naturalist I feel this strongly, and the extinction of so many curious and beautiful forms of life which human progress occasions is very painful to contemplate. It seems to us hateful that the harmonious results of Nature's conflicting powers should be disturbed and upset to meet the vulgar needs of uncultured human life.

Yet reason should convince us that this sentiment is a mistaken one. We may, indeed, most reasonably regret the loss of species of animals and plants which greater care and foresight might have preserved; yet we should never forget that over the irrational world man legitimately holds sway, and that weighed in the balance with him the rest counts for nothing. The very poorest homestead, the ugliest row of cottages, the most common-

* [December Monthly, pp. 189, 190.]

† [December Monthly, p. 187.] The Italics are mine.

place suburb, and the manufacturer's chimney, with its grimy surroundings and furnaces which make verdure impossible, are each of them priceless in value compared with all the charms of irrational Nature which the most skillful poet can depict. They are of such value, because each is an arena wherein good thoughts and words and deeds may find a place, and so help on the world to fulfill what is for us its one great end.

A nature must be wonderful indeed which demands for its existence the reversal of that great cosmic process which, so far as we know, has ever and everywhere prevailed antecedently to its advent. The difference between a being of so transcendent a nature and every other must surely be something altogether different from the difference between mercury grass and a field buttercup, or between a wolf and a badger!

But the reader must not imagine I would represent Prof. Huxley as an entirely conscious convert to a view opposed to that he had before advocated. Some of his utterances concord with the latter, and I can not presume to say to which he will ultimately adhere.

Thus, as to the future of evolution, he tells us: *

> Some day, I doubt not, we shall arrive at an understanding of the evolution of the æsthetic faculty.

He affirms also that those who seek to find "the origin of the moral sentiments" [the right honorable professor's term for ethical perceptions] in evolution "are on the right track."

In a note † he declares that—

> Strictly speaking, social life and the ethical process, in virtue of which it advances toward perfection, are *part and parcel* of the general process of evolution, just as the gregarious habit of innumerable plants and animals, which has been of immense advantage to them, is so.

Is this only an inconsistent adherence to old opinions, or is it meant to be seriously maintained as an essential truth? If the latter, it nullifies all that was said as to the distinctness of the ethical process and the wonderful reversal of the great cosmic process by man! Every one knew that gregarious creatures, such as wolves, have different habits from solitary animals, such as badgers, and many know that the growth of mercury grass has consequences whereof that of the buttercup is devoid. No prophet need arise in Israel to tell us such things as these. No special university lecture was required to teach them to us, and I, for one, must decline to believe that all those eloquent expressions which have been quoted—respecting "righteousness being the

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* [December Monthly, p. 187.]

† [December Monthly.] Note, p. 188. The Italics are mine.

very heart of goodness"; the explicit denial that evolution can teach us why good is to be preferred to evil, and the representation of the ethical combating the cosmic process—mean no more than that a difference has been established essentially similar to that which exists between social and solitary caterpillars.

I am confident that in my interpretation I can only be doing the right honorable professor justice, for who out of Bedlam would call the gregarious mode of growth of a patch of mercury grass an *ethical process?* We might just as truly attribute "calculation" to crystals, and "amorousness" to oxygen.

Of course, evolution will cause a social organism so to grow or so to act as not to destroy itself. To do this is one thing, to see that it is its *duty* so to act is quite another.

Prof. Huxley informs us * that to his knowledge no one

> professes to doubt that, so far as we possess a power of bettering things, it is our paramount duty to use it and to train all our intellect and energy to the service of our kind.

But it is questionable whether some pessimists would not only doubt, but even deny, this assertion; and it is only too plain that, without *professing* to *doubt* it, multitudes of men and women by their actions practically *deny* it. Prof. Huxley's assertion is an uncompromising "categorical imperative," and, of course, will receive the support of absolute morality; but whence does he derive such an ethical ideal? Man did not voluntarily and consciously invent it. It was *in* him, but not *of* him. To this it may be replied that only developed man has such perceptions, and that the thoughtless brains of a savage are devoid of all ethical intuitions, while every one must admit that the infant gives no evidence of their presence. But to say that because the infant does not *manifest* them it does not possess them, would be as reasonable as to say that because a field shows no sprouting corn there can be no corn beneath its surface! As to savages, I have elsewhere † stated my reason for believing they have essentially the same nature that we have ourselves. If I were wrong in this, I should not regard them as men. I should not care if it could be proved that intellect and ethical perception did not anywhere exist a hundred years ago. I know that they exist *now,* and I know that a being who possesses them is, and must be, of an absolutely different nature from one who does not. As a fact, I think few will dispute that most infants which live to adult age and many savages who come in close contact with Europeans clearly demonstrate that their "*nature*" was rational, however tardy and impeded may have been their manifestation of rationality.

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* [December Monthly, p. 187.]

† See On Truth (Kegan Paul, Trench & Co.), chapter xix, pp. 282–294.

But the advent of a being who has such faculties as man has, and whose career *really* conflicts with, and reverses the great process of cosmic evolution, may well have had an origin different in kind from that of every other animal—at least, so far as regards his intellectual principle.* For he is a being with two natures in one person, and thus it is that when we speak of "the whole of Nature," or "the natural world," a definition of our meaning is needed in order to avoid ambiguity. The term "Nature" may be used in a broad or in a narrow sense.

In the broad sense † of the word, it includes man with all his powers and their effects, while in the narrow sense of the word Nature he is excluded from it.

Much may be said for the latter use of the term, since man, by his intelligence and will, is able to change the whole course of physical causation. Thus his power, when contrasted with all the other powers of Nature known to us, may, in a sense, be termed "supernatural," and he may be truly said to "perform miracles." So great, indeed, is the contrast and distance between man and the world of irrational nature, that it suggests now, as it suggested of old, a contrast and difference on the other side—I mean, it suggested the existence of a "real supernatural"—of a mode of being which is raised above all human nature, as man himself is raised above all infra-human nature.

And so I come to one of the corollaries which I think results from such a change of view with respect to man as the words above quoted ‡ from Prof. Huxley would seem to indicate—namely, the recognition of a Divine All-perfect Creator of the world and man.

This corollary Prof. Huxley seems as yet indisposed to admit, although he has elsewhere * spoken of man as "here and there reflecting a ray from the infinite source of truth!" He is, as yet, plainly indisposed to admit it, because he declares ‖ that the exist-

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* In my Genesis of Species (1871), p. 325, I said: "Man, according to the old scholastic definition, is a rational animal (*animal rationale*), and his animality is distinct in nature from his rationality, though inseparably joined during life in one common personality. Man's animal body must have had a different source from that of the spiritual soul which informs it, owing to the distinctness of the two orders to which these two existences severally belong. . . . That the first man should have had this double origin agrees with what we now experience. For, supposing each human soul to be directly and immediately created, yet each human body is evolved by the ordinary operation of natural physical laws. . . . Man is, indeed, compound; in him two distinct orders of being impinge and mingle; and with this composite nature an origin from two concurrent modes of action is congruous, and might be expected *a priori*."

† The sense used by me in my Lessons from Nature (John Murray), 1876.

‡ See p. 327.

* See Man's Place in Nature, p. 112.

‖ [December Monthly, p. 181.]

ence of evil is incompatible with the existence of an omnipotent and infinitely beneficent Cause.

But, assuming the existence of evil to be to us inexplicable, we are but thereby landed in a choice of difficulties, between which, it seems to me, no rational man should for one moment hesitate.

One difficulty is the existence of a complex Cosmos, which could never have been naturally selected, and whereof intelligence and goodness (in ourselves) form part, without an adequate cause —i. e., without God.* To regard this non-theistic view as a possibility is, in my eyes, the acme of irrationality.

The other difficulty is the possible accord with God's infinite goodness, of evil, permitted for purposes we can not conceive of, and due to attributes higher than, though not inconsistent with, beneficence. How any one, who has not the presumption of pretending to understand what God is, can really find this second difficulty a serious one, is to me amazing.

Christianity can supply not only an explanation but also a profound consolation for the troubles of this life, and mere ordinary experience shows us that things we have now and then desired would, if obtained, have been baneful for us, as also that apparent evils have been blessings in disguise. Prof. Huxley, indeed, very truly says: †

> That there is a "soul of good in things evil" is unquestionable; nor will any wise man deny the disciplinary value of pain and sorrow.

On this we have often insisted; but none the less we are from asserting that ours is the best of all possible worlds. All I would affirm is that God must have created a Cosmos such as to respond most fitly to the intention of a Being infinite in intelligence and goodness, but also possessing attributes of which we can have no conception whatever.

Heartily do I echo Prof. Huxley's denunciation of the words, "Whatever is, is right," as opposed to all our noblest aspirations, and most true is his remark ‡ that—

> To the man with an ethical ideal, the world, including himself, will always seem full of evil.

But the teaching of the lecture, as a whole, is a depressing one. Many years ago Prof. Huxley taught * that in "sadness" lay "the essence of all religion," and little comfort is to be gained from his

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* As to "Natural Selection" in this relation, and as to adequacy and the eternity of the Cosmos and its Cause, see On Truth, chapter xxvi, pp. 450–499.

† [December Monthly, p. 182.] His difficulty rather concerns the merely animal world. As to this question, space does not allow me to do more than refer my readers to my book On Truth, p. 471.

‡ [December Monthly, p. 182, note.]

* Lay Sermons (1870), p. 15.

latest utterance. He tells us,* "The theory of evolution encourages no millennial anticipations." This is true, indeed; and though the world's existence may seem long when measured by the span of a human life, it is but "a flash in the pan" compared with the infinite ages. And if we suppose the cosmic process to continue indefinitely, and suns with their attendant planets so to pulsate into and from separate existence, yet it promises nothing for all mankind but absolute annihilation and utter nothingness.

The Oxford lecturer, however, discoursing on truly "vain philosophy," predicts a mere recurrence of pulsations for the best human thought. Its modern form, he tells us †—

> is making a fresh start from the base whence Indian and Greek philosophy set out; and, the human mind being very much what it was six and twenty centuries ago, there is no ground for wonder if it presents indications of a tendency to move along the old lines to the same results.

The human mind is, of course, very much what it was, but it has now what then it had not—the light of Christianity to aid its progress. Its influence has ground and sharpened the weapons of the intellect as they have never been ground and sharpened before. No doubt, the prejudices which have grown up under the teaching of Descartes and Locke, which have been intensified by Berkeley, and which culminated in Hume, will continue to dominate those who can not extricate themselves from that sophistical labyrinth wherein I was once myself imprisoned. The labyrinthine spell, which makes escape impossible, consists in the words: "We can be supremely certain of nothing but our own present feelings." Hypnotized by this formula, the victims fancy they can not know with certainty their own substantial and continuous existence. But the spell is at once dissolved by the recognition that such feelings are *not* primary declarations of consciousness, but simply the result of an act of reflection parallel with that which tells us of our own persistent being.‡

The dreams of Brahmanism and Buddhism, Ionian philosophy, Idealism, which may be called the philosophy of Janus,* and the noble inconsistencies of pantheistic Stoicism are all impossible for those who have come to apprehend the truths enshrined in Christian philosophy.

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* [December Monthly, p. 190.] † [December Monthly, p. 186.]

‡ It is, of course, impossible in these pages to draw out the reasons which justify the above assertion. For them the reader is referred to my book On Truth, chapters i, ii, and ix.

* Because the system can readily be inverted so as to become materialism. Its materialistic face belongs to it as properly as does its idealistic visage. Prof. Huxley says [November Monthly, p. 31], "Granting the premises, I am not aware of any escape from Berkeley's conclusion." Neither am I. But I am no less unaware of any necessity to accept those premises, the truth of which I unhesitatingly deny.

It would be an important approximation toward that philosophy on the part of the second Romanes lecturer, if those words of his I have here cited signify an acceptance of the distinction between what is "formal" and what only "material" in the sphere of ethics on the one hand, and an appreciation of the essentially distinct nature of man on the other. His expressions seem to me to justify the hope that the process of mental evolution has in him had this result.

I can not, however, regard them as decisive. It may be I have been deluded by my earnest wish that those words,

> Whose faith and work were bells of full accord,

which have been said of a valued friend of us both, may one day also be said of him. If, however, I have been mistaken, I shall not on that account cease to hope that ultimately my wish will be fulfilled.

For my own part my conviction grows ever stronger that, though corporeally man is but a sort of ape, his intellectual nature is so distinct that, thus considered, there is more difference between him and the orang than between the latter and the ground beneath its feet.

But high as he is raised above the rest of Nature, the very limitations of his reason, considered in the light of the highest ethical aspirations of his being, demand something beyond Nature —a Divine revelation.

This is what the higher races of mankind seem to me to have, consciously or unconsciously, sought and striven for, from the dawn of history till the advent of Christianity. The acceptance of that revelation (of course without the surrender of a single truth of physical, biological, historical, or any other science) is, I believe, the logical outcome of the Theistic corollary implied by that power of ethical intuition which so forcibly proclaims both the responsibilities and the dignity of man.—*The Nineteenth Century.*

An incident related by Persifer Frazer in his biographical sketch, in the American Geologist, of Thomas Sterry Hunt, may be regarded as illustrating the force with which first impressions strike the mind. At the first scientific convention which the young chemist and geologist attended, that of the Association of American Geologists and Naturalists, in 1845, Dr. C. T. Jackson read a communication on the copper and silver of Keweenaw Point, and Prof. H. D. Rogers submitted some remarks on the question of the Taconic rocks, two subjects which afterward received great attention from Dr. Hunt to the last days of his life. "One might easily and perhaps profitably trace," Dr. Frazer remarks, "the origin of many investigations which Dr. Hunt has pursued to brilliant discoveries in the sometimes vague but to him suggestive questions and observations at these scientific meetings."

HOW THE SEA IS SOUNDED.

By G. W. LITTLEHALES.

IT was not until long after astronomers had begun to sound out the realms of space and to measure the distances and weigh the masses of the planets that the longing which has always existed in the human mind to know more of the mysteries of the sea began to be gratified. Indeed, the deep sea remained unfathomed and mysterious until after the second half of the present century had dawned upon the world; and the contemplative mariner of fifty years ago, as he looked upon the heaving bosom of the ocean and wondered at its mysteries, had nothing but myths and legends to sustain his meditation.

Under the stimulus created by the achievements in investigating the earth, the air, and the heavens attempts had already been made to fathom the ocean both by sound and pressure, but in what sailors call "blue water" every trial was a failure repeated.

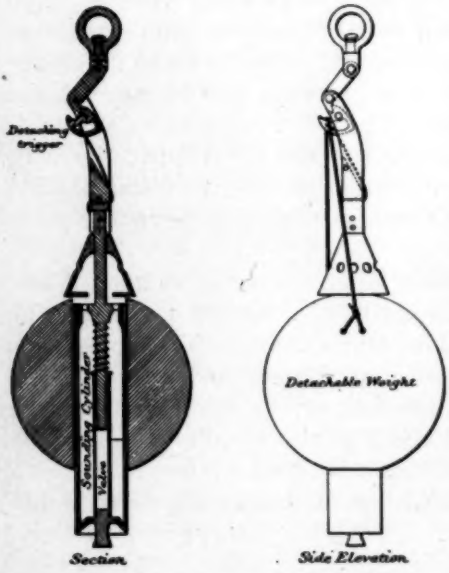

FIG. 1.—MODERN SOUNDING CYLINDER.

In 1856, Maury writes: "The most ingenious and beautiful contrivances for deep-sea sounding were resorted to. By exploding heavy charges of powder in the deep sea, when the winds were hushed and all was still, the echo or reverberation from the bottom might, it was held, be heard and the depth determined from the rate at which sound travels through water. But though the explosions took place many feet below the surface, echo was silent and the sea gave out no answer. Ericsson and others constructed deep-sea leads having a column of air in them which, by compression, would show the pressure of the water to which they might be subjected, and therefore the depth. This plan was found to answer well for ordinary purposes, but in the depths of "blue water," where the pressure is equal to several hundred atmospheres, the trial was more than these instruments could stand."

Lieutenant Maury planned and constructed an ingenious deep-

sea sounding apparatus in which there was attached to the lead, upon the principle of the screw propeller, a small piece of clockwork for registering the number of revolutions made by the little screw during its descent; and it having been ascertained by experiment in shoal water that the apparatus in descending would cause the propeller to make one revolution for every fathom of perpendicular descent, hands provided with the power of self-registration were attached to the dial, and the instrument was complete. It worked well in moderate depths, but failed in the deep sea on account of the difficulty of getting it down if the line used were large enough to give the requisite strength for hauling up.

FIG. 2.—THE SOUNDING CYLINDER WITH SHOT ATTACHED.

Such was the state of the development of the appliances for measuring the depths of the sea in the middle of the present century, when the idea of using a heavy weight attached to a simple hempen cord was proposed. The plan of stretching a line under the strain of a weight at its lower end from the surface to the bottom underlies the method which is now universally employed for sounding the depths of the sea. In shoal water there is cast from the vessel a plummet in the form of an elongated truncated cone attached to a hempen cord which has been previously divided into feet or fathoms. The line is allowed to run out through the hands of a man who detects, by the sense of touch, the instant when the lead reaches the bottom, and reads the depth by noting the division of the line which corresponds with the surface of the water. By filling a small cavity in the base of the lead with tallow, a quantity of the sand or gravel or mud upon which the lead strikes becomes imbedded in the tallow and gives an indication of the character of the bottom soil.

The rough surface of a rope presents an obstacle to its free passage through the water, and therefore as the depths increase it is necessary to employ heavier weights to carry the line swiftly in a straight course to the bottom, and, moreover, stronger rope to bear the increased weight of the sinker. In great depths the size of the rope which is necessary is such as to present considerable surface to the action of submarine currents, which carry the line

more and more out of the vertical direction in proportion to the duration of the passage of the sinker to the bottom, and render the results less and less accurate. Moreover, as the weight of the submerged portion of the rope in addition to the weight of the sinker soon becomes so heavy that a man can not lift it, and therefore can not assure himself by the sense of touch when the lead has reached the bottom; and as the weight of the submerged parts is sufficient at great depths to cause the unwinding of the reel, the line may continue to pass out long after the sinker has reached bottom, and the length unwound may thus bear no relation to the depth to be measured. In addition to these sources of error there is another arising from the drift of the vessel during the period of several hours which is required to effect a deep-sea sounding with rope.

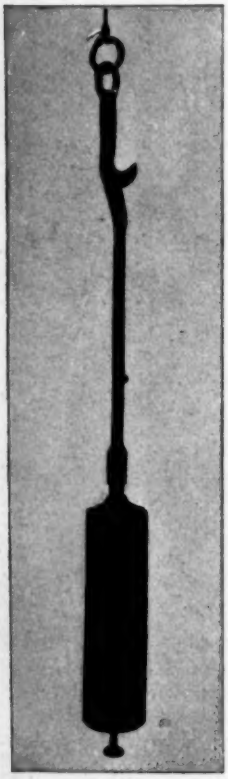

FIG. 3.—THE SOUNDING CYLINDER AS IT IS HOISTED FROM THE BOTTOM AFTER THE SINKER HAS SLIPPED OFF.

These causes, tending to carry the line off in the direction of the subsurface currents in an ever-increasing complication of loops and bends, and impeding more and more the velocity of the fall of the plummet until it sinks into the oozy soil without communicating to the surface any evidence of its arrival at the bottom, explain the reports of the vast depths of the sea that astonished the public mind less than half a century ago. Lieutenant Berryman, of the United States brig Dolphin, reported an unsuccessful attempt to fathom mid-ocean with a line thirty-nine thousand feet in length. Captain Denham, of her Britannic Majesty's ship Herald, reported bottom in the South Atlantic at a depth of forty-six thousand feet; and Lieutenant J. P. Parker, of the United States frigate Congress, in attempting to sound the same region, let go his plummet and saw fifty thousand feet of line run out after it as though the bottom had not been reached. The deepest spot in the South Atlantic is not more than twenty thousand feet beneath the rolling waves that sealed its mysteries fifty years ago; and the deepest spot yet discovered in the world not more than twenty-eight thousand feet.

By the use of wire for sounding great depths many of the difficulties and uncertainties which characterize the use of rope are obviated, for the wire, being light in weight and of small cross-section, is not greatly affected by submarine currents, but allows

the sinker to pass swiftly to the bottom. While the apparatus for sounding the sea consisted of a weight secured to the end of a hempen cord which was paid out from a simple reel on the deck of a vessel, no reliability could be attained in the measurement of depths, because the cord employed was necessarily so large as to become a controlling element in the weight of the system. But when the project for the Atlantic telegraph cable made it necessary to obtain accurate measurements of the depth of the ocean, Midshipman Brooke, of the United States Navy, took the first great step in providing means for trustworthy deep-sea sounding by inventing an implement in which the sinker, enveloping a tube secured to the sounding

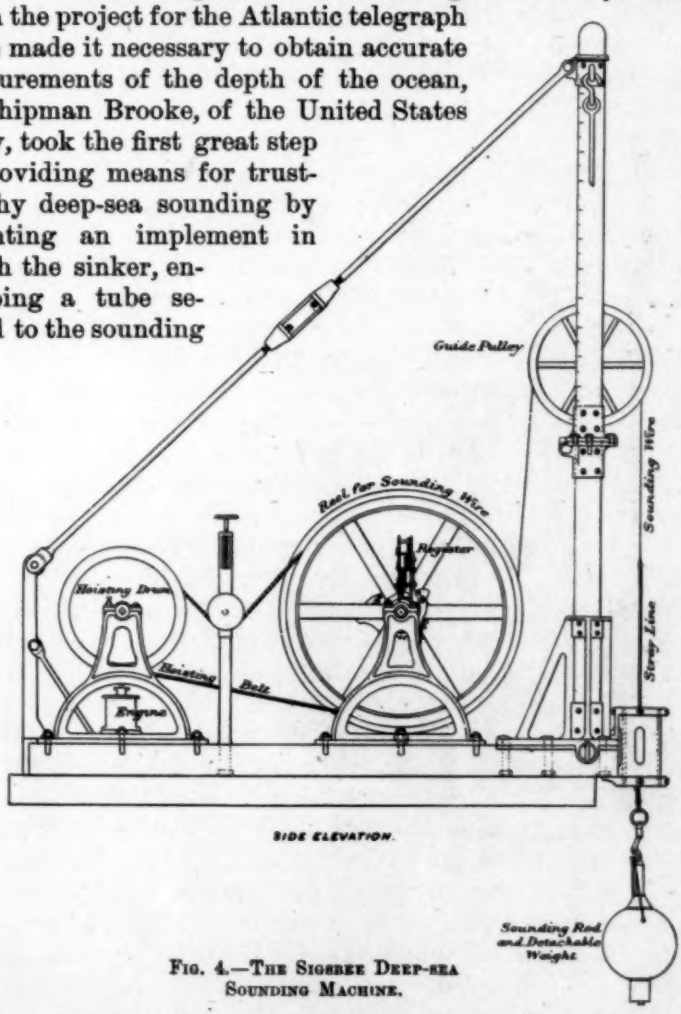

FIG. 4.—THE SIGSBEE DEEP-SEA SOUNDING MACHINE.

line, was detached on striking the bottom and left behind when the tube was drawn up.

The modern form of deep-sea sounding cylinder, which is the result of the experience of Commander Sigsbee, of the United States Navy, during his great work in developing the orography of the Gulf of Mexico, is provided with valves at the upper and lower ends which open upward, and during the descent allow

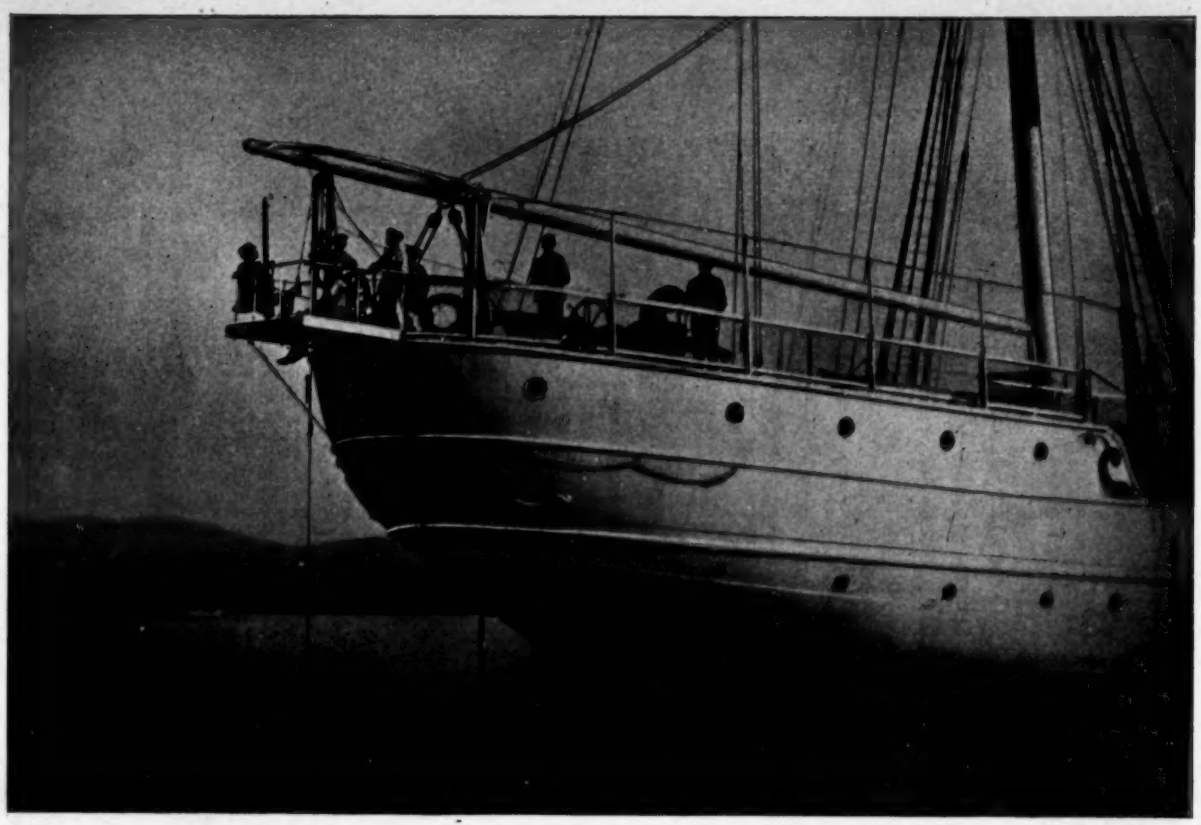

FIG. 5.—ABOUT TO SOUND FROM THE UNITED STATES FISH COMMISSION STEAMER ALBATROSS.

the water to pass freely through the cylinder so that it experiences a minimum of resistance. On striking the bottom, the slackening of the sounding line, which is secured to the ring shown at the upper end in the accompanying illustration, causes the trigger to spring back and release the sling that supports the detachable weight. As the lower end of the sounding cylinder sinks into the bottom a specimen of the soil forces itself through the lower valve and lodges in the interior of the cylinder. When the cylinder is hauled up the valves at the top and bottom are closed by their own weight and the pressure of the water, and the specimen is sealed until its arrival at the surface, when it is removed for examination by unscrewing the upper and lower halves of the cylinder.

In 1872 Sir William Thomson (Lord Kelvin) succeeded in adapting piano-forte wire to successful use as a sounding line in his navigational sounding machine, and a few years afterward Commander Sigsbee, besides contributing by his inventive genius most of the smaller instruments and implements used in modern deep-sea research, achieved the crowning triumph of the art in his elaborate deep-sea sounding machine, by which, while relieving the delicate sounding wire from the sudden strains to which it would otherwise be exposed by the pitching of the ship while lying to for the purpose of sounding, the profoundest depths are measured with celerity and exactness.

In this machine the wire passes outboard from the reeling drum over a guide pulley mounted on a crosshead that works between two upright guide frames. Each of the guide frames incloses a spiral spring called an accumulator, which is connected with the guide pulley by means of a rope that passes over a pulley at the top of the guide frame. If the ship is suddenly borne upon the top of a wave while the sinker is going down, instead of causing a jerking strain upon the sounding line, the stress is communicated to the guide pulley, which moves downward under the additional load and extends the accumulator springs; and, likewise, when the ship suddenly sinks into the trough of a wave, the tendency to slack the sounding line is counteracted by a rise in the guide pulley brought about by the normal tendency of the accumulator springs to contract.

A ship regularly engaged in deep-sea sounding usually has the sounding machine mounted at the after end, and when about to sound is brought to a standstill with the stern to the sea. The stray line with the sounding rod and sinker attached is over the guide pulley and carefully lowered to the water's edge, the register is set to zero, and the deep-sea thermometer is clamped to the sounding line; a seaman is stationed at the friction line which controls the velocity with which the wire is unreeled, another at

the brake, and a third on the grating outside to handle the sinker and instruments and to guide the wire as it passes overboard; a machinist is at the hoisting engine, and the recorder takes a position for reading the register. When the sinker is let go, the vessel is manœuvred so as to keep the wire vertical, and the friction line is adjusted so as to allow it to descend from seventy to one hundred fathoms per minute. The instant the sinker strikes bot-

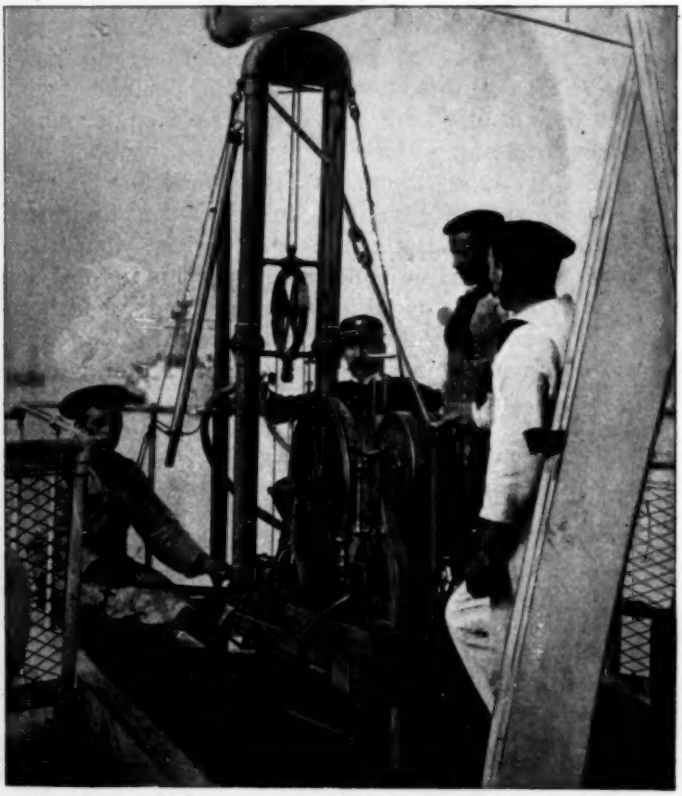

FIG. 6.—SOUNDING: THE SINKER GOING DOWN.

tom, which is unmistakably indicated by the sudden release of the wire from strain, the reel is stopped by the friction line and brake; the recorder notes the number of turns of the reel indicated by the register and determines the depth; the cranks are shipped and sufficient wire is hove in by hand to allow the end of the sounding rod to clear the bottom. Steam is then admitted to the cylinder of the hoisting engine, and the wire is reeled in slowly at first but finally at the rate of one hundred to one hundred and fifty fathoms per minute. The last ten fathoms are reeled in by hand, then the thermometer is read and the specimen of the bottom soil brought up in the sounding cylinder is examined.

In an hour this messenger of man's ingenuity makes its excursion through five miles of watery waste to the abysmal regions of perfect repose and brings to the light of day the soil with which the rain of shells of minute infusorial organisms from the upper

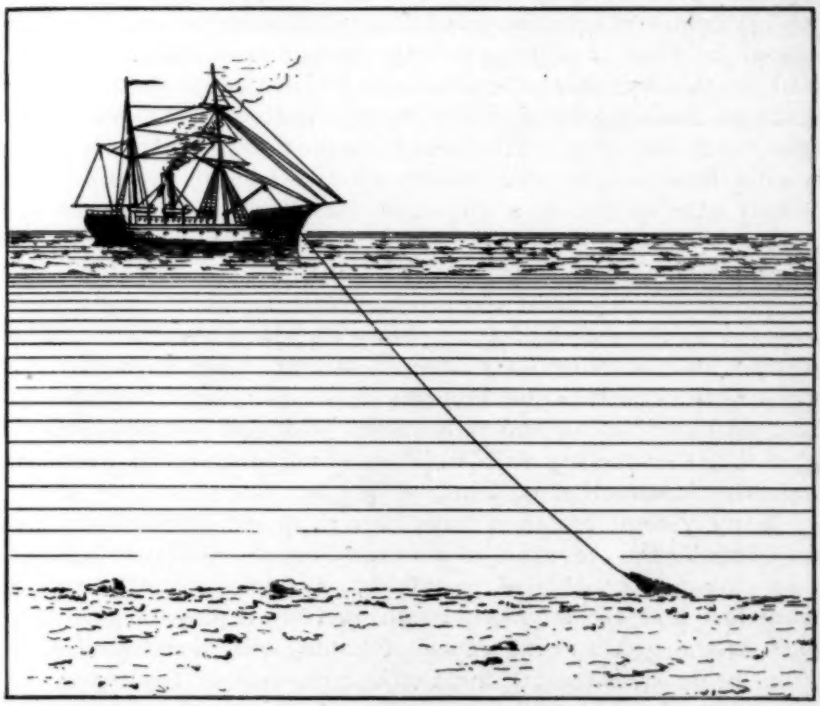

FIG. 7.—DREDGING.

waters has been for ages mantling the ocean's floor. Here and there a giant peak rising from these sunless depths lifts his head to see the sky, and the dredge and trawl tell us that all along his rugged sides, and on the hills and plains below, and even in the inky blackness and the freezing cold of the deepest valleys, there is life.

THE origin of life, said Dr. J. S. Burdon-Sanderson in his presidential address before the British Association, "the first transition from non-living to living, is a riddle which lies outside of our scope. No seriously minded person, however, doubts that organized Nature, as it now presents itself to us, has become what it is by a process of gradual perfecting or advancement, brought about by the elimination of those organisms which failed to obey the fundamental principle of adaptation. . . . Each step, therefore, in this evolution is a reaction to external influences, the motive of which is essentially the same as that by which from moment to moment the organism governs itself. And the whole process is a necessary outcome of the fact that those organisms are most prosperous which look best after their own welfare."

EMOTIONS AND INFECTION.

By M. CH. FÉRÉ.*

THE relation that exists between the activity of the nervous system and resistance to causes of destruction may be illustrated by facts of different sorts. It has been often remarked, and the registers of the academies confirm it, that we find many old men among scientific and literary people. Whether the resistance in question is attributable to the habitual exercise of the mental functions, or vital resistance and mental power are conjointly attributable to a good natural organization, the relation is no less certain. The same relation is found, susceptible of like interpretations, among persons without cultivation, whose existence has been, as we might say, all organic, and who are more exposed to the action of atmospheric inclemencies and to all the chances of mortality. The remark is attributed to Baillon by Cabanis that porters and laboring men offer only a feeble resistance to blood-letting and purgatives. Nothing is more remarkable than the facility with which weak-minded persons succumb to acute diseases of every kind.

Many violent maladies have been supposed to have been produced under the operation of moral influences. Sennert believed that fear was capable of provoking erysipelas. Hoffmann also made fear and the adynamy resulting from it play an important part as the predisposing cause of contagious diseases. Dr. H. Tuke believed, in particular, in the influence of fear upon the contagion of rabies. The breaking out of rabies has been sometimes observed after psychic emotion. Bouley cites the case of a dog which went mad after having been immersed in water. Gamléia cites a similar case in a man, and another in a woman who was frightened by a drunken man. In order to avoid the influence of fear, Desgenettes concealed the name and the nature of the plague; and it is to be remarked further that the Turks died less rapidly of it than the Christians. Cullen supposed that sad emotions favor contagious diseases, and particularly the plague. This disposition to contagion after violent emotions which determine discharge of the secretions may be partly explained by the fact that the conditions that diminish the proportion of the liquids of the blood favor absorption. It, however, seems at least probable that the nervous discharge is accompanied by alterations of the blood and modifications of the interior medium which justify the popular expressions concerning having bad blood and turning the blood. It is admitted that

* From his work on the Pathology of the Emotions. Paris: Félix Alcan.

violent emotion is capable of causing and of curing intermittent fever. In the latter part of June, 1889, M. Jullien, a surgeon of Saint-Lazare, called me in consultation over a neurasthenic and hypochondriac patient who thought he was suffering from ataxy. He was a vigorous man, without any stigmatic marks of degenerescence, but very emotional. He had had some attacks of marsh fever in Poland about twelve years before, but had not suffered from it since. At St. Petersburg, when near the place where Czar Alexander II tragically perished, he experienced a violent emotion, after which he suffered for three days attacks of well-characterized fever. A new attack came on at Paris a few months before my visit, corresponding with the emotion he experienced on finding a friend dead in the Hôpital Beaujon.

The old authors give the moral emotions a part in most eruptive fevers. We meet them in the etiology of cholera. Pneumonia sometimes appears on the occasion of a strong moral emotion. Rostan relates the story of a woman who was suddenly struck with a very severe pneumonia on receiving news of the death of her son. Grisalle observed it in a woman who, learning that she had been robbed, experienced instantly a violent attack, which was followed promptly by a chill, a stitch in the side, and spitting of blood.

Depressing emotions often seem to have an action on the development of tuberculosis. Laënnec believed that griefs and annoyances were important constituents in the frequency of phthisis in large cities.

Puerperal infection is also favored by depressing moral emotions. "I have often in my practice," says M. Hervieux, "seen young women in childbed, in a fair way toward recovery, take a chill and become mortally ill after a visit or untimely reproaches from their mother or relatives; or after the agitation or perplexity occasioned by their resolving to abandon their child, unfortunate girls, till then doing well, falling ill on carrying out the resolution and succumbing in a short time." Rivière, Willis, Denman, Delaroche, Paul Dubois, Alexis Moreau, Tonnelé, and others attribute an important part in the etiology of diseases of women in childbed to the moral affections; and this opinion is supported by more recent observations.

The emotions, likewise, have a part in the evolution of surgical diseases, and particularly in their infectious complications. The theories recently put forth to explain contagion and immunity from infectious diseases may agree with the facts we have learned relative to the influence of the emotions. Among these theories is one to which the facts lend an important support. In this theory the mesodermic cells, and particularly the white globules, are charged with the protection of the organism against the in-

vasion of microbes. We know that the leucocytes have the property of moving and putting out prolongations, by means of which they surround foreign bodies and force them into the mass of their protoplasm. They behave in a similar way toward microbes, which, once surrounded, are destroyed by a real intracellular digestion, and we give the name of *phagocytism* to the whole of these operations. Now, dilatation of the peripheric vessels occurs in sthenic emotions, in which it is manifested by ruddiness, increase of volume, and functional exaltation. In asthenic emotions, on the contrary, inverse phenomena betray a diminution of circulation and a decrease in the caliber of the vessels, and consequently a condition unfavorable to the sally of the white globules and to phagoyctism. Asthenic emotions, from this point of view, lead to the same conditions as traumatisms, fatigue (Charrin and Bogen), chill (Pasteur, Wagner, Platania, Charrin), inanition (Canalis and Morpurgo), loss of blood (Serafini), and nervous sections (Charrin and Ruffer, Roger and Herman).

Not only do the conditions of the vessels change, but the phagocytes and the white globules especially are modified as to their vitality and their chimiotaxy, and their property of being attracted or repelled by the microbes or their products of secretion vary under the same circumstances. Under the influence of cold the white globules tend to become paralyzed. MM. Massert and Bordet, whose experiments seem to demonstrate the absence of a relation between the chimiotaxic action of the leucocytes and the condition of the vessels, admit that under defective conditions of nutrition the whole organism is more easily impregnated by a poison which provokes at every point the chimiotactic activity of the leucocytes, which then have no occasion to direct themselves toward any particular point. The modifications in the composition of the blood after nervous excitements and under emotions which we have mentioned can also be adapted to this theory. Experimental data show that in all conditions in which nutrition is deficient—and painful emotion is one of these conditions—infection is caught more easily. Evidence of this is not only derived from animals; I have had occasion to observe on man several facts which give support to results obtained in the laboratory.

Having to revaccinate patients in my practice, I inoculated a dozen hemiplegic persons symmetrically in both arms in order to see whether the paralyzed side would offer a different resistance to the virus. Real vaccine was not developed in any of these patients, all of them having been vaccinated not more than three or four years before. Upon three of them only were developed pustules of false vaccine, exclusively on the hemiplegic side of one, and with a marked predominence of volume and duration on the other two.

In the case of a little girl eighteen months old, afflicted with infantile spinal paralysis of the left leg, with considerable chill, I made four punctures on the outer side of each arm with a lancet carefully charged with vaccine matter; the inoculation was successful only on the diseased side. Some more recent experiments bear in the same direction. On the other hand, certain medicines quieting to the nervous system, like opium, morphine, chloral, and bromide of potassium, seem also to favor infection.

The influence of the emotions on infection is further susceptible of a direct experimental demonstration. Having under my care a number of weak-minded persons susceptible of taking interest in a monotonous exercise, I profited by the opportunity to try upon a considerable number of animals—pigeons, rabbits, and white mice—the effect of fear, which was excited by means of noise or threatening motions, through several consecutive hours. The experiments may be divided into three groups: 1. The blood of frightened animals and of witnessing animals was sown. While the blood of the latter animals was sterile, that of the former gave in half the cases more or less numerous colonies of microbes. 2. Animals, some of which had been left at rest, and others had been disturbed, were inoculated with cultivations of pathogenic microbes—of carbuncle, hen cholera, pneumo-enteritis of swine, and Fraenkel's pneumococcus. In all the experiments, without exception, the frightened animals died first, if the cultivations were virulent; while if the cultivations were attenuated they alone died or were ill. We have seen animals little susceptible to an infection succumb to it under the influence of fear; frightened pigeons yielded to pneumo-enteritis of swine, while mere witnesses did not appear to be affected at all. 3. On introducing under the skin of the ear or of the brow of rabbits, or under the skin of the wing of pigeons, capillary tubes closed at the end and filled with cultivations of pathogenic microbes or of saprophytes, we discovered considerable differences in the chimiotactic properties of the white globules, according to the condition of the animals. With frightened animals the tubes were often found at the end of thirty-four hours entirely filled with transparent liquid, while with witness animals the tubes containing whitish trails through their whole length were choked at the ends with a compact wad of leucocytes two or three millimetres long. Most of the microbes had disappeared in the case of healthy animals, while a very large number of them remained in the fluid of the other animals, in which the microscope could discover only a very few leucocytes. We are therefore able to show experimentally in frightened animals that one of the conditions of resistance to infection is absent. The study of these facts deserves to be pursued in detail.

We know the influence local traumatisms have on the location

of the accidents of infection and of diseases of nutrition. Moral shock is in reality equivalent to a cerebral commotion; and, without forcing analogies too far, we are able to understand that it all the more readily can provoke cerebral lesions.—*Translated for The Popular Science Monthly from the Revue Scientifique.*

UNCLE SAM'S LIFE SAVERS.

By FRANK G. CARPENTER.

THE United States Life-saving Service is now one of the great institutions of our Government. Its system embraces the dangerous parts of our Great Lakes and oceans, and its hundreds of stations cover a coast line of more than ten thousand miles in length. It began to be as far back as 1848, but in its present organization its life commenced in 1871, when Congress made an appropriation of $200,000 and established some experimental stations along the New Jersey coast. These at once showed the value of the system, and to-day on the Atlantic and Gulf of Mexico there are one hundred and eighty-two different stations, while there are about fifty on the chain of the Great Lakes, and a steadily increasing number on the Pacific.

The buildings are located sufficiently far from the water line to be safe from high tides. They are plain structures, designed to serve as barracks for the crews and to afford convenient storage for boats and apparatus. Each station is generally equipped with two surfboats and their accessories, two sets of "breeches-buoy" apparatus, life lines, life car, a vehicle for the transportation of boats to points where needed, a Lyle gun, cork jackets, signal lights, rockets and flags, well-equipped medicine chest, instruments of various kinds, together with everything necessary for the comfort and well-being of the crews. Where practicable along the Atlantic coast, the stations are connected by telephone. At a few points there are long stretches of uninhabitable coast, and houses of refuge have been established at intervals of about twenty miles for the shelter of shipwrecked persons. They are supplied with cots and provisions for twenty-five persons for ten days. On the Ohio River, at Louisville, there is a floating station. The great rise and fall of the river renders impracticable the use of a stationary building. In recent floods the crew of this station were of incalculable service to the people of Louisville. Hundreds of imperiled persons were rescued, and thousands who for days could not leave their houses were supplied with food and other necessaries.

Each station and its crew are in charge of a "keeper," who

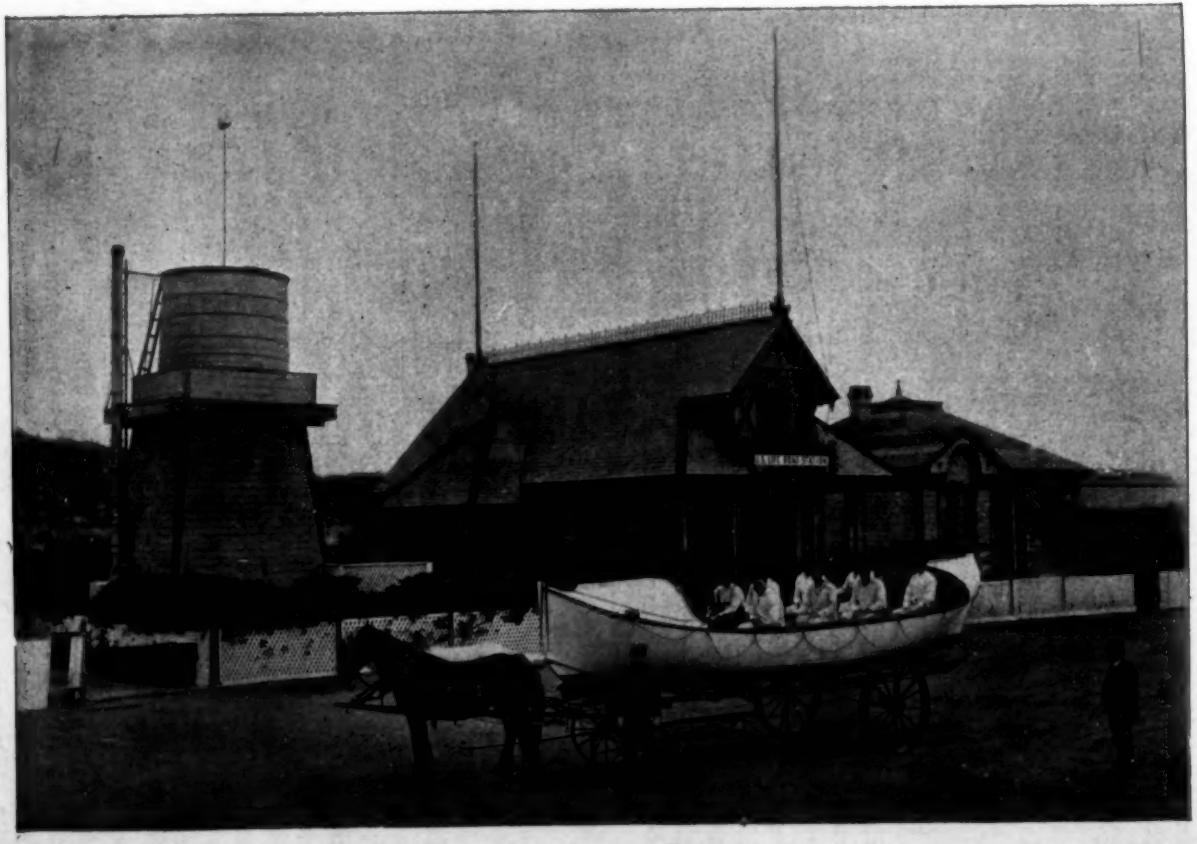

FIG. 1.—READY TO START.

must be of good character and habits, sound, able-bodied, and a master of boatcraft and "surfing." He must live at the station, exercise absolute control over the crew, and direct all operations. In times of danger he must lead where duty calls, sharing with the men all the perils of wind and wave. The crew usually numbers six or seven, who are selected with especial reference to their fitness for the service required of them. It is indispensable that they be experienced surfmen and skilled in the handling of boats. It may be here remarked that political considerations have not the slightest influence in the life-saving service from its chief down. If politics were permitted to dictate appointments, a serious impairment of the service would speedily result.

A surfman is paid sixty-five dollars per month, with no allowances except quarters at the station. He provides his own food and clothing. No man or officer is permitted to have an interest in any wrecking apparatus, or to be connected with any wrecking company; nor is he entitled to salvage upon any property saved. If disabled in the line of duty, a member of the crew receives full pay during such disability, not exceeding one year. If he loses his life—and this is not infrequent—his widow or children under the age of sixteen are entitled to his pay for two years.

When the season of active duty begins, the men establish themselves at the station for a residence of eight months, embracing on the sea-coast the autumn, winter, and spring seasons. On the Great Lakes their active service is from the opening to the close of navigation. For domestic convenience they resolve themselves into a committee of the whole which they term a "mess." They take weekly turns in catering and cooking. The keeper organizes his crew for the season, designating them as Number 1, Number 2, etc., in the order of merit and efficiency. Each man holds rank according to his number. Watches are kept by day and patrols by night. If two stations are within communicating distance, the patrols meet midway each time they traverse their beats. Every patrolman is equipped with signal lights with which to warn vessels or to give an alarm in case a vessel in distress is discovered.

The members of the crew are drilled daily in the handling of boats and life-saving appliances. By practice they acquire agility and expertness that are almost incredible. The highest possible efficiency in times of actual service is thus secured. The men are also instructed and practiced in applying the most approved methods for the restoration of persons apparently drowned. In some cases this is accomplished after twenty or thirty minutes of unconsciousness. It will be readily understood that these men must possess great courage and powers of endurance. Their service is full of danger and often their lives are in extreme

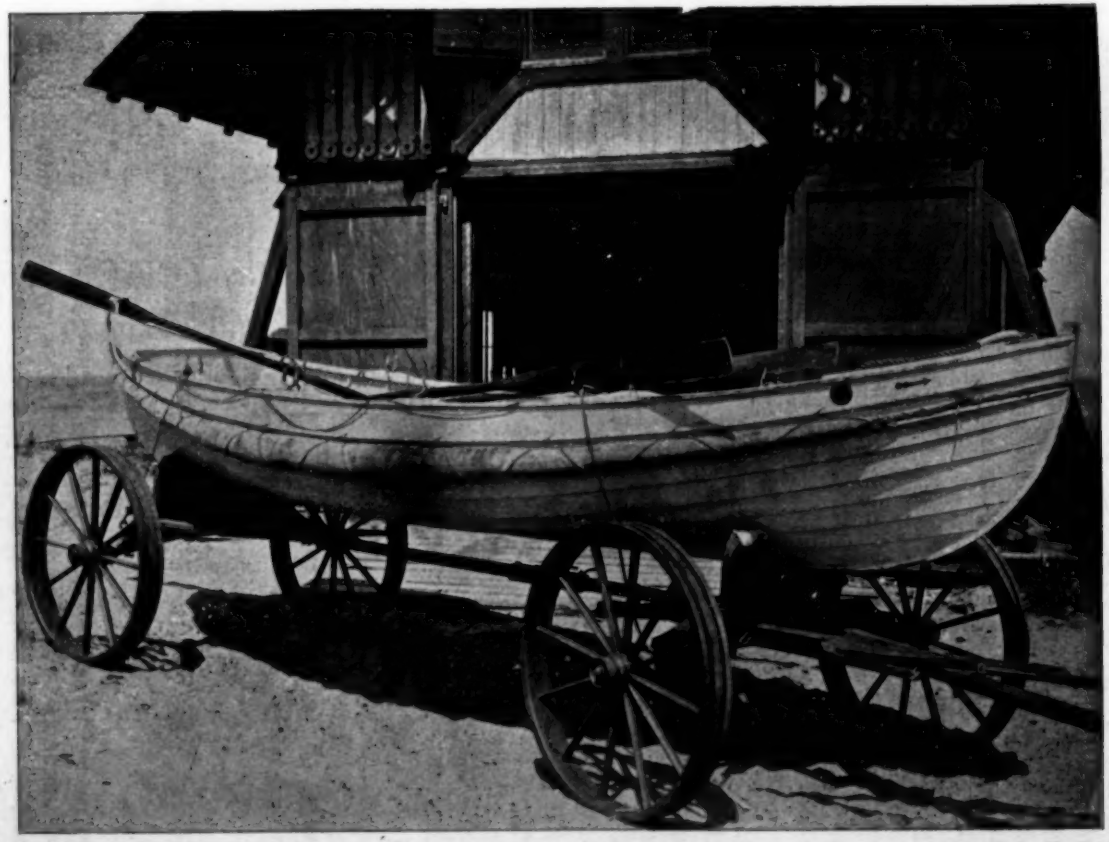

FIG. 2.—SURFBOAT.

jeopardy. Their devotion to duty and humanity are beyond praise.

For convenience of supervision the stations are grouped into districts, of which there are twelve. Each is in charge of a superintendent, who must, at least once a quarter, visit the stations in his district, and who is held responsible for their condition in all respects.

The means employed to rescue people from stranded vessels are everywhere essentially the same. The tumultuous waters be-

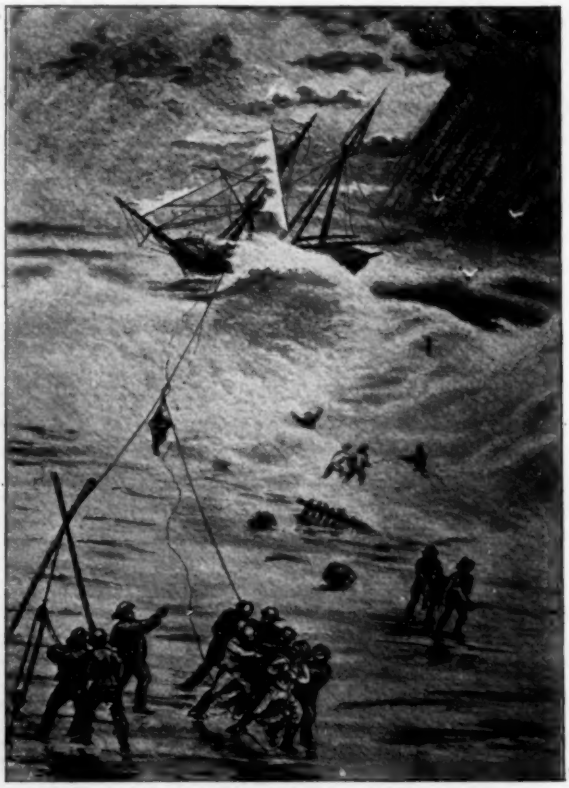

FIG. 3.—BRINGING CREW ASHORE IN BREECHES BUOY.

tween the wreck and the shore are either crossed by a lifeboat or are spanned by strong lines over which a car or breeches buoy is passed to and from a wreck. There are many kinds of lifeboats and many other devices for effecting communication by lines between a wreck and the shore. The type of boat in most general use in our service is distinctively known as a surfboat. It is made of white cedar upon a white-oak frame. It is from twenty-five to twenty-seven feet in length, with its other dimensions proportionate. It is propelled by six oars, and will carry, besides the

crew, from ten to fifteen persons. The excellence of these boats is shown by the record during the eighteen years they have been used in the hands of the life-saving crews. They have been launched in actual service six thousand seven hundred and thirty times, and have safely landed from wrecked vessels six thousand seven hundred and thirty-five persons. They have capsized but fourteen times, six of these accidents being attended with loss of life. Of the boats' crews, twenty-seven were drowned, being one for every two hundred and forty lives saved.

A "self-righting" lifeboat is largely used in the English service, and in our own to a limited extent by way of experiment. This boat is constructed with air-chambers at the bow and stern and several hundred pounds of iron in the keel. These cause the boat to "right" itself when capsized by the waves. It is of necessity heavy and cumbersome, and the record for actual service is on the whole favorable to the smaller and lighter surfboats adopted by our own Government. The proportionate loss of life from capsizing is considerably less with the surfboats. The self-righting boat is fourfold heavier than the other, weighing about four thousand pounds. Boats are being constantly improved and perfected, one of the latest devices being for self-bailing, by which water that may be "shipped," or fills the boat as the result of a capsize, is instantly expelled. A boat combining successfully the properties of self-righting and self-bailing would seem to be the nearest possible approach to the ideal.

The "Lyle gun" is the means adopted for effecting line communication with stranded vessels. It is of bronze, and of 2½-inch bore. It weighs with its carriage but a hundred and eighty-five pounds, and throws a shot weighing seventeen pounds. This projectile is a solid cylinder fourteen inches and a half in length, into the base of which is fixed an eyebolt for attaching the shot-line. The latter is from an eighth to a quarter of an inch in diameter, and pays out from a coil as the projectile flies upon its way. The aim is to carry the projectile directly over the vessel in distress. The line falling upon the deck is seized by the sailors, and by it a large line is hauled from the shore and made fast, affording means for the immediate use of the life-saving appliances. The Lyle gun will project a line, under favorable conditions, a distance of seven hundred yards. It is easily operated by day or night. During a storm at night great skillfulness of aim is necessary, as there is no guide save the dim light upon the swaying vessel. When the distance is not too great, the practiced eye rarely fails.

The vehicle in most common use, in this and other countries, for transporting persons to the shore, is the "breeches buoy." It is a primitive, simple, and yet most effectual means of saving life.

It will carry but one person at a time, but it is easily and rapidly handled, and this fact renders it invaluable. It is made of stout canvas, something like a pair of breeches for the legs, from which it takes its name. From a circular float which comes just under the armpits ropes are attached, which suspend the buoy from a pulley block running upon the large line. It takes but a minute for a man to fix himself in the "breeches," and then he is hauled through the air—perhaps part of the way through the water—to the shore. Whenever practicable, the line at the vessel is fastened

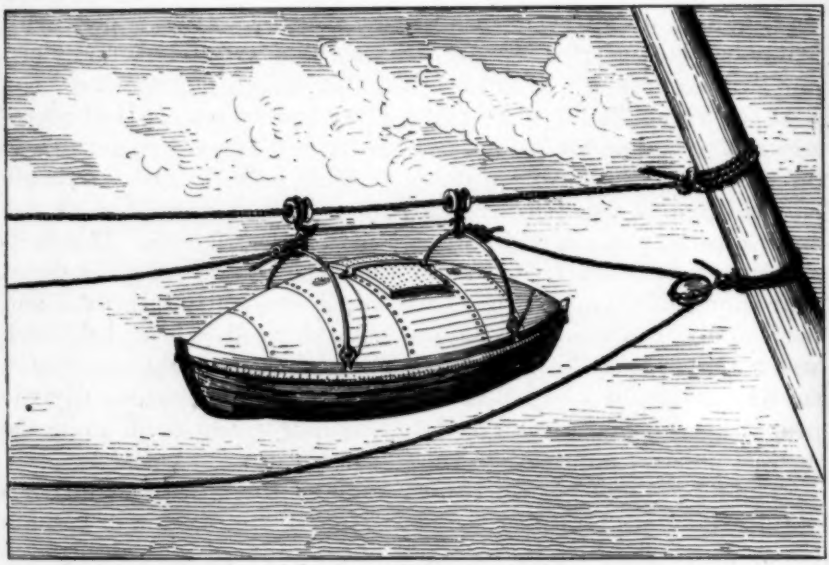

FIG. 4.—LIFE CAR. United States Life-saving Service.

tight upon a mast, so that the passage may be made without immersion. Many thousands of lives in all parts of the world have been saved by this simple but effective device.

The "life car" is brought into requisition when the number of persons to be saved is large and circumstances require that the work be done quickly, as when a vessel shows signs of breaking up. It is a covered boat, perfectly tight with the exception of a few small holes for the admission of the air. It may be hauled upon the water by means of lines, or suspended from the hawser and passed to and from the wreck. It will contain six or seven persons, and is a comparatively safe and speedy means of rescue. The life car was designed by Joseph Francis, who but a short time ago received, at the hands of the President, a superb gold medal, voted by Congress in recognition of its value. Upon the first occasion of its use more than two hundred persons were safely landed from a wreck.

The value of the telephone as a means of communication between contiguous stations was lately illustrated. During one of the worst and most destructive storms that ever visited the Atlantic coast a large number of vessels were driven ashore at and near Cape Henlopen. The crews of three life-saving stations were summoned, and their combined labor effected the rescue of a hundred and ninety-four persons from twenty-two vessels. Of these, a hundred and thirty-five were landed with the "breeches buoy." Not one life was lost during the operations. Crews, with their boats and apparatus, are often transported long distances by rail to meet emergencies. On the shore of Lake Superior such a trip was once made a distance of a hundred and ten miles, the railway train running at the utmost possible speed. The spot was reached at midnight, and in the midst of a blinding snowstorm thirty-four persons were brought safely to shore from two stranded vessels.

At the stations shipwrecked persons are cared for with dry clothing, nourishment, and medicines. Often they are exhausted by exposure or hunger, or injured by the accidents of wreck and rescue. Frequently they are to all appearances dead. The record shows that during the existence of the life-saving service there have been treated a hundred and eighteen cases of apparent death. In sixty of these resuscitation was successful, failing in fifty-eight. In a few instances respiration was restored after several hours had elapsed. While the saving of life is the primary object of the service, it has a secondary duty in the saving of property, which runs up into the millions.

Before the service was established no statistics of loss of life were recorded, so that it is not possible to show by comparison the decrease of deaths by shipwreck as the result of the efforts of the life-savers. It is learned from authentic information, however, that upon the Long Island and New Jersey coasts, during the twenty years from 1850 to 1870, the average annual loss of life was twenty-five; while during eighteen years of the service the yearly average has been but seven. No doubt a similar ratio would apply to other points of danger along our coasts. Each successive year shows a better record, as life-saving appliances are more nearly perfected, abundantly attesting the efficiency and value of this branch of Government effort in behalf of its people.

In the opinion of Mr. Henry Seebohm, the extreme views of the theory of an ice age have been to a large extent abandoned. No one now believes in the former existence of a polar ice cap, and possibly when the irresistible force of ice-dammed rivers has been fully realized, the estimated area of glaciation may be considerably reduced. The so-called great ice age may have been a great snow age, with local centers of glaciation on the higher grounds.

WINDOW LIGHTS AND THEIR VALUE.

By JAMES L. GREENLEAF,
ADJUNCT PROFESSOR OF CIVIL ENGINEERING IN COLUMBIA COLLEGE.

MOST subjects of analysis can be studied both in quantity and quality, and light is no exception to the rule. Color as a quality of light has always been a popular study. A vast deal of experiment and attention has been given to the harmonics of color, and many who make no claim to scientific attainment are well versed in it. Every child knows the colors, but the expression "quantity of daylight" has a strangeness and a vagueness about it that are not felt by children only. This is largely because there is such a wealth of daylight about us. "Silver was nothing accounted of in the days of Solomon." Light is not measured, because it is lavished upon us by an unstinting hand. But light can be measured. Although intangible, it has quantity—quantity of effect, if it may be so expressed. If this seems fanciful, it may be remarked that there is nothing fanciful about the measurement of heat, and yet the case is quite analogous. The thermometer is simply a contrivance for measuring variation of intensity in heat. Quantities of heat effect are continually being estimated, for economy in its use is of prime importance. Light, on the contrary, is ready at hand. Ordinarily objects are flooded with a brilliancy of daylight which is as free as air. There can scarcely be need of economy with light when the world is floating in it. But there is nothing impossible in its measurement. Possibly, if the sun were less prodigal in pouring out his rays upon the earth the measurement of daylight would be a more common operation than at present. Every means would be taken to utilize it without waste. We would see the owners of buildings making careful estimates of the light belonging to their properties—even dividing it into lots and renting them separately. At the least, we would see them more jealously than now defending their light from obstructions built around them.

Windows are the natural and all-important resource of the architect. All the light which enters the building must pass through them. It is a very patent fact that the larger they are, and the more numerous, the greater the total amount of light which enters. It is not as widely appreciated, however, that there are other conditions affecting the amount and quality of the entering light that are sometimes ruling in their effect.

Looking from a window, one sees a variety of surfaces—sees them because of their reflecting different intensities and colors of light. If asked to classify them according to relative reflecting

power, he will probably speak of the sky first as the great source of light to the window. Then, if he does not ignore them altogether, the objects on the earth are grouped in one class of comparatively little importance. This is not Nature's method. There is no sharp division between the strong reflecting surfaces and the weak, between the sky and the earth. We are prone to such a distinction, because the sky seems prominent as a reflecting surface, but it can be shown that circumstances arise when this is by no means true.

Imagine the window to look out upon a landscape. Earth, foliage, and sky all combine to reflect light into the room. The water may be very dark, from the shadow of overhanging trees, reflecting less than ten per cent as much light as comes from the sky, but there is a path across it where the sunlight is cast back far more brilliant than the sky itself. The beaten highway gleams in the sun so that it is a relief to look away from it into the blue above. Even the foliage, delightfully dark and cool in the shadows, may have a brightness where the sunlight strikes it which is fifty or eighty per cent of the intensity of sky light.

On turning from the country to the city view we find the lessened importance of the sky as a source of light especially emphasized. There the great value of space causes one building to encroach upon the sky light of another until frequently the patch of blue visible from the windows is limited to a mere streak, or may be cut off entirely. If the sky were the only means of lighting, the windows would be useless in such cases; but the fronts of buildings, the paved streets, and other surfaces combine to throw much light into them, and give a reason for their existence.

The reflecting power of the sky dome is due almost entirely to the particles of vapor contained in the atmosphere, and hence must be considerably affected by changes in its aqueous condition. Contrary to what might be imagined, the clearer the sky the less valuable is it as a reflector. The more haze that it contains within limits the more intense the light obtained from it. An observer will recall dreamy summer days when the sun has seemed to shine softly as through a gauze cast over its face and the shadows were mellowed and diffused, yet the sky was white with a radiance painful to the eye. There was little suggestion of ethereal blue in the white light sent down from this atmosphere charged with particles of moisture. Again, a clear day comes; the air fairly dances with brilliancy, and distant objects stand out in the sunlight as clear-cut as a silhouette. The sky is a beautiful Italian blue, but does it occur to one how really dark it is except in the immediate vicinity of the sun? Try to match it with a sheet of blue paper, and it is almost startling to discover what a somber surface the sky dome is. Its value as a source of light is greatly

less than on days when it is a duller blue, or when gray better describes its color. Some experiments which are at hand show a difference of over seventy per cent in the reflecting power of the northwest sky on two sunshiny days, and they were by no means extremes of the two conditions of atmosphere discussed. No experiments upon extreme states of the atmosphere are available, but it is safe to say that the reflecting power of the sky dome in this climate is one and a half times greater on some days than on others. Between the extremes are all possible variations.

Thus far the thought has been only of an unbroken expanse of sky, but if clouds float across the field they greatly change the conditions. A cumulus cloud piled high in great masses is carried past the window by the wind. It gleams beneath the sun's rays like a ball of cotton, and pours down a flood of light that may have as much as four times the intensity of the light from the sky directly beside it. At another time heavy thunder clouds will roll up from the horizon—a dark gray, unillumined by the sun. They obscure the sky and replace it by possibly ten per cent of its intensity of light.

Indeed, does it not seem as if there were no stability about the sky light? And yet, brushing the clouds aside, it will be found that the changes in any one day are not usually great. There is enough permanency in its reflecting power to make it serve as a practical standard of comparison—a standard not for the direct sunlight, which so far transcends any other light on the earth as to be unique, but for the vast variety of lights which crowd into the windows—the reflections from brick and stone, from wood and paint, from earth, water, and foliage.

Turning from the sky to the earth, a vast variety of reflecting surfaces is encountered. Each has its peculiar power of altering the light it reflects, both in intensity and quality. The amount of their influence upon window light is apt to be underestimated. Many rooms through the entire day and nearly all rooms for a portion of it have no direct sunlight, and all the light they do receive is entirely by reflection. Of this the portion coming from surfaces on the earth is a very considerable part.*

It is true that most surfaces reflect but a small percentage of the light which strikes them, but when that light is the great flood from the sun itself the pittance which comes from them is

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* In a number of cases carefully determined in city locations it has been found that the sky gave only from eight to forty per cent of the total light reaching a point inside a window on the ground floor. The remainder came from opposite building surfaces and from the street—this, with the sun shining upon these reflecting surfaces. At another time of day the sky value would be comparatively greater, yet not so much as might be imagined, because all the surfaces would not lie in shadow at the same time.

by no means contemptible. An illustration of this may be given. While reading on the shady side of a railway car one afternoon, a sudden flush of warm-tinted light seemed to cover the page and as quickly it was replaced by a cold gray light. The change was very noticeable and the cause easily revealed. At intervals along the track were stretches of rough-faced masonry, perhaps seven feet high. The stones looked in shadow a dull gray and a buff color, but when the sun struck them they glowed with a light that flashed into the car window. In spite of the fact that the area of sky light was far the greater of the two, that rough retaining wall determined in a great measure the character and intensity of the illumination on the paper.

Light-colored surfaces are the most valuable reflectors, and among them white paint and whitewash stand pre-eminent.* Even in shade, when illuminated only by other objects or by the sky, they will give sixty per cent or more of an average sky light. Sometimes they will run up to the full value of sky light, if a reflecting surface near by shines brightly upon them, or they may fall to twenty per cent or even less in deep shadow. But when the direct rays of the sun fall upon a newly whitewashed surface, the volume of light it reflects is almost blinding. Three hundred to four hundred per cent is not too large an estimate to place upon it in comparison with the sky light. On this account the well-known expedient is used of whitewashing or painting in some bright tint the walls of a light-shaft or surfaces facing a window which is much shut in. A case is known of the rear of a house so treated being in summer time a source of great annoyance to dwellers on the next street, because of the blaze of light reflected into their rear windows. White marble is quite similar in its powers of reflection. A striking example can be seen in the spires of St. Patrick's Cathedral in New York. Rising far above the dust of the city, they are not yet covered with its grime, and their pure white glistens in beautiful contrast to the dark blue of the sky.

From the white of paint or marble there are many variations in building surfaces, all the way down to black. A large number are to be found among the granites. Some varieties are very dark in tone, reflecting little light unless polished, but the gray granites give considerable light. A freshly tooled gray granite will certainly yield one hundred per cent of sky light when in sunshine, and some varieties give far more. The writer has known the gray granite of an old building to give one hundred and forty

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* The percentages stated in the following pages are based upon a large number of photometric measurements of the light from building surfaces, made by the writer at various times and places.

per cent, as compared with the sky light of a clear day. When it was in shadow the intensity fell to only ten per cent.

The brownstone, so familiar in building construction, is justly looked upon as a gloomy material for the purpose. Connecticut stone is the darkest, and, especially when oiled, is a somber thing with which to enliven architecture. But even when oiled it does not absorb quite all the light which strikes it. The searching light of the sun will find many little particles among the grains of the exterior that give surface reflection, and this white light mingles with the dark interior hue of the stone to brighten it considerably. The Connecticut stone under ordinary conditions gives some sixty to seventy per cent of the intensity of sky light, when the sun shines brightly upon it. Belleville stone is much lighter, and has been shown to exceed the sky light by twenty or thirty per cent when illuminated by the sun.

Among the bricks there is a large opportunity for choice in their capacity for reflecting light. The Philadelphia pressed brick is popular for its richness of color, but deserves no prominence for its reflecting power. In that respect the coarser Hudson River brick is an improvement. There is, of course, considerable variety, but it may in general be said that walls of Philadelphia brick, and those painted red to imitate that shade, will reflect sunlight to an extent varying between fifty and eighty per cent of ordinary sky light. When illumined by only indirect light from the sky or other sources they have an intensity of fifteen to twenty per cent of the same sky light. With rough brick walls there is always a considerable show of light-colored mortar, and this, with the lighter surface of the bricks themselves, causes a greater reflecting power. It is easy to find surfaces of this character with a reflecting power when illuminated of ninety to one hundred per cent.

Buff-colored bricks make admirable reflecting surfaces. With the sun upon such a surface it will often reflect one hundred and sixty per cent or more of sky-light intensity. Many opportunities will offer in modern construction for the observer to bring such an illuminated surface against a sky background, and see how much brighter it will ordinarily be. Its practical value as a reflector is greatly lowered in his estimation, however, when he finds that, if the sun is not shining upon it, twenty-five per cent is a liberal estimate of its powers of reflection.

The climax of reflecting power in brickwork is reached in the cream and white enamel brick that are in the market. They are chiefly used for interior work, and their polished surfaces place them in a different class of reflectors from the ordinary building materials.

Slate roofs belong to the same class in a certain degree. The

ordinary slate when held in the hand appears a very dark blue; little light is reflected from the interior, and that little is mainly blue, while the very small amount of white light reflected from the surface is not enough to pale the interior hue to any great extent. But turn the slate so as to reflect the light differently, and then there is such an excess of surface reflection as to give even a silvery tone to what was a moment before a dark material. A twist of the wrist will easily make a difference of two hundred per cent in the reflecting power. The extremes and all the intermediate conditions can be seen in slate roofs, and these are in a position where comparison is easily made with the sky. One roof will look almost black, as it stands out against the sky; another that reflects the sunlight will gleam like a white sail on the horizon. At another time it may melt away with a hue and shade that are not to be distinguished from those of the blue sky back of it. The same effect is obtained with shingles, but in a less degree.

The pavement of city streets affords some interesting observations. It is ordinarily looked upon as only fit to be trodden under foot of man, and very little credit is given its reflecting power. Paving stones appear of a rather somber color when held in the hand, and ordinary blue flagstone is similar. Hence it is surprising to learn that dry flagging, when illuminated by sunlight, is about the equal of the highly prized sky as a reflector of light. A considerable number of experiments, taken at various times and places, go to show this. Under ordinary conditions of dirt the pavement may be slightly darker than the bluestone flagging, but they will both give approximately one hundred per cent of sky light. Moreover, their hue is not unlike that of many skies. The idea is perhaps difficult to grasp, in view of their condition; but if a section of New York street could be purified and translated, it would quickly be lost to sight, ascending in a sky of its own color. When in shadow, fifteen to twenty per cent represents the amount of light that the street will give as compared with the sky. If the stones are wet, not more than ten per cent of light comes from them, except where there may be a powerful reflection of white light from the water upon the surface.

It has perhaps been noticed that thus far, in discussing reflecting surfaces, attention has been confined to the changes they produced in the intensity of light. These are not, however, the only alterations that occur. Quality as well as intensity is affected by the surfaces which throw light into the window. Leaving now the intensity of reflecting power, let us endeavor to realize what is taking place in every city street. It may be a thoroughfare filled with the noise of travel, but the air is crowded with silent lines of light. Back and forth they fly in all directions, every

surface receiving light, every little grain and fiber acting as a reflector to send it out again. Reflection and re-reflection are taking place with enormous rush and intricacy. But the extent of complication is not yet reached. These various lights are not all white. Each substance has its effect upon the light that it reflects. Some of the light undulations are absorbed, and those reflected give the effect of color characteristics of the object. The colored lights are then flashing back and forth, continually changing as they leave the different surfaces. Neither is this a complete statement of the situation. Each surface is illuminated by a variety of colored lights, depending upon the surfaces opposite it. The color of any one material depends upon the color of the light striking it, as well as upon its own nature. Hence possibly none of the surfaces in the street are seen in their true tones, the hues belonging to them when illuminated by pure white sunlight. They are slightly off color, modified by the colored lights that strike them. All this wonderful play of lights darting across the street is put in action by the steady, powerful, pure white flood of light coming from the sun.

It may be questioned why this condition of affairs is not more noticeable. Why are not the bright hues of the rainbow seen in all directions? The absence of brilliant coloring is briefly accounted for by the large amount of surface reflection taking place, through which we see objects as if a gray glazing had been washed over them.

However, conditions will occur when there is a very noticeable flush of color cast over objects which is not their normal hue, and it can be traced to the predominating influence of some one of the reflecting surfaces. Occasionally most striking effects of this character are seen during the sunset hour. Sun-illumined clouds are in the west holding their bright color when all other sources of light in sky and earth are waning. The predominating power of their colored light is enough to make a modest little sunset in the east, and the sky there will glow with a soft tint sympathetic with the display in the opposite part of the heavens. The western sky may even give a glamour of colored light to the landscape, casting a weird, strange effect over meadow and hillside, ere they disappear in the darkness.

> "Where the quiet-colored end of evening smiles miles and miles on the solitary pastures. . . . "

Those who use colored parasols understand perfectly the result, if not the theory, when the lining of the parasol is selected so as to add to natural charms by casting a soft flush of color over the complexion.

But illustration of the influence of the effect of surfaces upon

the color of light can be found in more prosaic subjects. Buildings offer examples. Ordinary brick and stone often have more influence than is imagined upon the light that enters windows. A brilliant although exceptional example of this occurred once in the writer's office. It has an eastern exposure and nearly opposite, at a distance of over one hundred feet, is a large red-brick building. The sky area exceeds all others, and ordinarily the amount of gray or light-blue light entering is enough to entirely overcome the effect of the red surface. On this special occasion, however, after a rainy day the sun suddenly burst through the clouds. The face of the building was illuminated by clear white sunlight, and stood out brilliantly against a backing of heavy, dark clouds. The effect in the office was most noticeable. Where had been nothing but a cold gray light in an instant a glare of red was cast over everything. Table and book that had been dull looked warm in color, and the walls appeared, as if by magic, in the most delicate rose tint fit for a fairy's boudoir. True, these were conditions most admirably adapted to illustrate the point that surfaces opposite windows can affect the quality as well as the intensity of the light reflected, but others more common lead to the same conclusion.

An excellent opportunity for alternating contrast is offered by a ride on an elevated city railway. Let one select a time in the afternoon when the eastern sky is not so bright as to obliterate the effect, and seat himself on the right-hand side of a down-town train in New York city. If the buildings are not too far removed from the track, a very decided change is noticed as each block is passed. Where the opening of the street brings a considerable sky area into view an ordinary gray light is cast upon the newspaper. This is succeeded by a sudden flush of rose as a high block of red-brick buildings is passed, and again a street opening allows the western sky to assert itself. Moreover, let it be noted that this may occur not with a bright sunlight pouring upon the buildings, but when they are in shadow, except as the eastern sky illuminates them.

Occasionally the effect of surfaces opposite the windows upon the color of the light can be noticed inside of buildings, even with no exceptional atmospheric conditions existing. On any clear day, by limiting the rays striking a marble slab in a certain room chiefly to those from a brick building opposite, one can change the white marble to a deep rose tint of a most beautiful shade.

These various illustrations have many corroborations in experience. They show that the light entering windows must be considerably influenced in color by reflecting surfaces opposite, even though the effect be not noticeable. Usually this is not a

matter of any concern, because a slight difference in hue from their appearance under pure white light does not materially affect our appreciation of most objects. There are, however, special operations which are thus affected to an extent that is of practical importance. A conversation with a cotton broker, for example, will do much to increase respect for the sensitiveness of the trained eye, and convince one of the practical bearing of these matters. Careful observation is needed to judge cotton and grade different samples, and the eye becomes wonderfully skilled in doing so. A steady, clear sky light is desirable. Evidence is at hand of the injurious change upon the light caused by alterations in buildings across the street from a cotton sample room. In the course of building operations in Pearl Street, New York city, a dull, buff-colored wall was taken down and replaced by red brick. The result when the sun shone upon the surface was a noticeable and injurious change in the light that came into the windows. A flush of pink was cast over the cotton samples, perhaps too slight to be noticed ordinarily, and yet giving a tone to them which interfered with the judgment of their quality.

And now a few words in conclusion concerning the service the light performs when it finally reaches the room. That light which passes directly from the window to the eye is of no benefit, except as it enables one to see the outside view. Nearly all the light serves a far more useful purpose. It enters the window and sets in operation on a smaller scale the same phenomena that are taking place in the street. It is bandied back and forth between walls, carpet, furniture, and occupants. The light that these various surfaces reflect gives impressions of form and color by which we appreciate objects. By means of it we see our friends' faces, enjoy the pictures, read the book. It should be noted that light and color are entirely subjective. They are effects produced in the brain by different kinds of light undulations. We perceive the color of the upholstery and carpet because these have the faculty of sorting out undulations of special wave lengths and reflecting them. We perceive the outline of chair or of face partly by change of color, but chiefly by light and shade, the difference in intensity of the undulations coming from them and from objects behind them. To make the objects in the room distinct the light entering the windows must be conserved as much as possible. This will best be accomplished by banishing all dark materials. Heavy hangings absorb light as well as dirt. Oak or enameled furniture reflects the light that black walnut or rosewood absorbs, and a light-colored wall will do almost as much as a sunny disposition to fill a room with sunshine and good cheer.

SPEECH FOR DEAF CHILDREN.

By LILLIE EGINTON WARREN.

LESS than thirty years ago no attempts were made to give speech to the deaf children of this country. Signs, writing, and finger-spelling were the means of communication employed. It had been a gigantic task to arrange a system of education for a class of persons previously supposed incapable of advancement, and it is not surprising that articulation in its early days fought hard for recognition among the older teachers. Happily, the spirit of opposition is waning, and there is now a friendly admiration manifested by them for the best intelligible speech given to the deaf. They are right in demanding that it be intelligible. It is easy to accustom one's ears to the articulation of a person seen daily, and if the pupil conversed with none but his relatives and teachers there might be no complaint about peculiarities. Such is not the case, however. With rare exceptions the deaf child must struggle in the world just as his hearing brothers and sisters do. The speech that comes easily to them is acquired by him at the expense of time and effort; it is his due that it should be made intelligible and agreeable.

As is generally known, the various States have large institutions for the deaf and dumb, or, as sometimes called, deaf-mutes. Dumb and mute are terms no longer applicable to the deaf who receive the best instruction; for it is now conceded to be a mark of neglected education to be unable to speak to some extent. Formerly they were dumb because deaf; now those who are dumb are so because untaught. The first superintendents to give articulation any place in their institutions considered it an added touch to give occasional pleasure. They were too strongly attached to signs to believe instruction in the various school branches could be given by speech and reading from the mouth. A comparatively few scholars, chiefly those who once heard, were put in classes and received lessons in speech a half hour daily, or four times a week, perhaps less. During the other hours there was no practical use of what was gained. In all the branches of the course, the teacher, in many cases a sign-taught mute, conducted the recitations in signs, finger-spelling, and writing. Spoken words were not used more than is German or French by the average child who has a lesson in the language with many others a few times a week. Thus articulation failed to obtain a fair opportunity to show its merits. Gradually some of the various obstacles to its success have been removed, and its teachers are making persistent efforts to secure to every deaf child a chance to speak and to read the lips.

Upon the question how far school instruction can be imparted through these means without the aid of signs and finger-spelling opinions differ. In justice to many it must be remembered that they receive all classes of pupils; often they are bright and in good physical condition, but some are diseased, of ignorant parentage, and small ability. It may be the latter class remain in school but a short time. While there, thanks to the State's generosity, they need not be of any expense to their relatives; it often happens, however, that they can not be spared long from home duties. The principal must arrange to give them all the knowledge he can while they remain with him. No plan covering years will answer for them. Neither will a plan suitable for them be sufficient for those better situated and conditioned. Perhaps the teacher is himself deaf, the graduate of some State institution, a member of one or more organizations of deaf-mutes, associating daily with sign-taught adults. Without casting any disparagement upon his abilities, we beg leave to say he is not as competent to decide the matter as a hearing person would be; he receives opinions from both sides, but he can not judge impartially. The greater his faith in the character of those who advocate articulation, the greater his faith in that system, but being sign-taught himself, he would like to feel his education was superior. Some principals have an oral department, by which is meant that a certain number of pupils are taught speech, and by speech receive instruction in all studies. As much as possible they are kept apart from the other pupils. This is a decided improvement upon the first arrangement, though it is a matter for regret that some should have such an advantage over others. A few superintendents feel this, and are arranging to have all new pupils taught speech, and as the older ones are graduated the manual department becomes small. Other institutions advocate a combined method, using both speech and signs with all pupils, one or the other system receiving the greater attention according to the views of the principal in charge. Schools have been opened which give instruction to all pupils by speech only, and are called oral schools, and a number of teachers are scattered over the country who fill the positions of resident or visiting governesses. Thus there is a disposition to advance the cause of the education of the deaf, and a wide difference in opinion as to what is best.

The true test is in results. That system is excellent which enables the deaf pupil to take his rightful place in the world, attain business and social success, to be like unto others. Correct, fluent speech, with voice more or less agreeable, and the ability to understand others by watching the facial movements (whch is called lip-reading or speech-reading), may be acquired by the boy or girl suddenly deprived of hearing by illness or born deaf. To

secure these desirable gifts the pupil must be educated by a system which gives speech in the beginning and imparts all instruction through that medium. Prof. A. S. Hill, in calling attention to the poor showing in written language even among the college-bred, dwells upon the importance of practice sufficient to enable the pupil to write without thought of the mechanical difficulties, maintaining that to be the first essential in efforts to acquire a good style. "A boy must have written much before he can form his letters without special pains; and much more before he can set down what he has to say without stumbling over punctuation, spelling, and grammar; and more still before he can write with facility." Upon the same principle the deaf child must articulate words long before he can do so readily; must speak in sentences long before he can do so fluently; and must talk on every occasion, to his teacher, to his classmate, in his lessons and in his play, before he can do so easily to the stranger and in society. Practice is the only means of attaining a spontaneous use of the vocal organs. Nothing else will do away with a consciousness of the mechanical difficulties.

The hearing power of the young infant is an unknown quantity, because the sensitive bundle of tissues responds quickly to impressions from various sources and is thus misleading. A loud noise may startle by its strong vibrations against the skin fully as readily as by the auditory sense. Intelligent parents have failed to discover deafness until their children were over a year old. The look of the very young deaf child is usually an interested one, accompanied by fewer unnecessary movements of the eye and less play of the facial muscles. From increased observant faculty comes a marked development of the imitative functions. The child's hands spring to his help. He goes through motions that he has noticed those about him use; in their case, however, speech and lack of observation have kept them from consciousness of those movements. They begin to see his, they are unaware of theirs; to them the child has invented his own signs. This fact discovers another. It is impossible for the normal human being of tender age to imitate easily a position of the mouth unaccompanied by the sound belonging to it; thereby proving the ear guides him more than the eye, and it is the absence of the hearing sense that obliges the vision to act early in behalf of the deaf child. A boy of two years was told to imitate what he saw in another's face; the lips were pursed, but he failed to round his until the sound of *oo* was made, though his deaf brother, noticing his difficulty, brought a spool to him to show the shape. Through hereditary tendencies the connection between the ear and the speech center is short and practicable; through educative means that between the eye and the speech center may be complete and

effective. Hearing need not be lacking to secure this result, for one possessing an acute ear may read speech from the facial movements. It is doubtful if there are many of the teachers of articulation to the deaf, a work requiring sensitive hearing, who consciously or unconsciously do not put to practical use some of their knowledge of the appearance given to the features by speech. This ability of the eye to take upon itself duties heretofore supposed to belong to the ear exclusively is a priceless boon to the deaf. Let others be instructed according to Francis Gouin's axiom: "The organ of language—ask the little child—is not the eye; it is the ear." We may add, if the ear has lost its cunning, the eye is a wonderful substitute.

The signs used in educating the deaf were perfected by hearing men and are arbitrary, learned by teacher as well as pupil, and unintelligible to most persons. The first signs employed by the little child, being copied from those in daily use among all classes of people, are termed natural. They express the putting on and taking off of the hat and coat, and thus the going out and the return home; the opening and closing of books, boxes, and doors; the acts of eating and drinking, driving, whipping, pushing, pulling, beckoning, running, and jumping. Animals are watched. The shape of the cat and the dog's mouths while giving their peculiar cries, "meaw" and "bow-wow," is copied; the curious action of the rabbit's legs when the creature is lifted by the ears is noticed and imitated; the first and second fingers of both hands raised to the head show that the movements of a horse's ears are observed. Impressions being conveyed through the sense of touch, the child communicates with others by describing in gestures the shape of the object he has felt. His eye has seen the form of a ball; but he knows more about it than the eye can reveal, for he has put his hands around it. Touch, taste, and smell come to his aid. The lack of facial movement gives place to grimaces; the nose becomes an expressive feature, and bitter and sweet, like and dislike, are revealed by strong looks. Accompanying ignorance of sounds there is an unconscious play of the vocal organs, forming a series of more or less unpleasant grunts and screams. The child's mental food is in what he sees, pictures or "images." He makes good use of all, showing an excellent ability to reason, but is liable to mistakes incidental to the fact that he may not have had the truth presented to him. A piece of chalk has been broken. He puts the parts together, appealing in that way to have it mended. His faith is large and his knowledge small. Some one takes them from him, dexterously substitutes a fresh crayon, and gives it to the child. He is not to blame for thinking it is possible to put together the pieces so perfectly that no one can see the mark of break. At another time, the honest-

minded person who tries to show him that such injuries can not be repaired will be thought unkind and unwilling to join the parts.

In the opinion of many, deaf persons are high-tempered, unruly, obstinate, and vindictive. The untrained, uneducated deaf may become so, just as the untrained, uneducated child in full possession of hearing may grow into a dangerous brute. It is not the deafness that is responsible. Too much stress can not be laid upon the importance of inculcating prompt obedience. There is no reason why a deaf child should not respond quickly to another's wishes. It is impossible to explain matters to him; teach him to obey, and let him learn by observation why he is required to do so. Obedience implies self-control. All progress, mental and moral, must be regulated by the greater or less amount of self-control. A deaf child may give a telling blow; unable to hear it, he fails to realize the degree of force exerted. How shall he be taught he has done wrong? By a blow directed to him? That would teach him that what he gave another can hurt, but what does he think of the adult who strikes him? Would he not be likely to feel that the older person by giving a blow practically indorsed its use? The next step would be to reason that it is justifiable to give one, but well to avoid receiving another in return. The best way to punish and thus teach the child to drop lawless expressions of his displeasure must be to show one's power without a trace of anger. If he is held firmly in a chair despite struggles and cries he will realize he is being controlled. He is conscious of his act and knows he is deprived of his liberty in consequence. He sees determination but no anger in the face of his instructor, and learns that tears and screams are unavailing. There is no need to indulge in such useless efforts. He has tired himself, only to find his keeper fresh and undaunted. A slap would have suggested retaliation. Pinching could be easily returned. This superior, calm strength is something different and so far beyond his own abilities as to compel respect. In time the expression in the face is sufficient to enforce obedience, and the hands need rarely exert their firm, strong hold. The child's conscience is formed by the series of impressions he receives from the decided approval or disapproval in the faces about him. There may be times when more severe punishment is required, but rarely if proper training is received in early life. It should be remembered that the deaf child is not conscious of the effect of the unpleasant screams and resounding kicks he may give when he throws himself down some day in temper. All his dramatic exhibition may have less behind it than has the "No, I won't!" of the hearing child. We admit that the scene made by one and the attitude of the other are equally unpleasant, but the

second may reveal greater defiance than the first. Speech is the expression of feeling, and feeling is best aroused through the hearing. Here is a means of cultivation cut off from the deaf. Can the education of the eye ever become sufficiently developed to atone for the loss in this direction? Most certainly not. The diversion made by hearing a remark, a laugh, a song, or a musical instrument has oftentimes prevented a quarrel, dissipated a worry, or broken a willful determination. The deaf are deprived of this means of receiving a fresh turn to thought, and this fact should be borne in mind when it is noticed that their disposition is not to give up a plan once adopted.

What the deaf may become if untaught is not an agreeable picture to face. Some idea may be formed by recalling that they were classed among the idiotic in the years they were neglected and deemed unworthy of efforts to educate. Here is a child, bright, healthy, and active, with an avenue to his brain obstructed. Reasoning from limited knowledge gathered by his observations alone, he misunderstands many efforts to do well by him. He is conscious of lack of communication with others; in a little while he may be morose and unhappy. Give him the speech he knows not, and the language that is to him a sealed book. With care during the first years it is possible to develop an agreeable voice. It would be wrong to claim it can become always musical or perfectly natural; just as wrong is it to assert that some voices happen to be good, some acquire peculiar tricks for which there is no remedy, or that it is right to be satisfied with any vocal efforts obtained. The exhaled breath pushing its way between the edges of the glottis becomes voice. If poor, it must be so from incorrect action of the edges; if good, from correct action. The teacher who understands how to secure the proper working of this delicate instrument can give the pupil a good voice. Speech is related to the affections more than to the intellect. The prompting of the actions of the vocal organs comes from the stirring of some emotion. If the intensity is great, cool judgment has no influence upon the voice unless long experience has developed self-control; if fear or timidity is felt, results are noticeable immediately. The deaf child's happy state is therefore absolutely the first essential for securing a warm or affectionate tone; next, his thoughts must be thrown out away from himself to enable the organs to act without tension. It is for this reason we are not impressed with the wisdom of educating the touch of the finger tips to feel the vibrations of the vocal cords, believing as we do that such a method by centering attention upon the throat, a part of the pupil's body, prevents the developing of pure, resonant tones.

The voice formed in the larynx is molded into the numerous vowels by various shapes assumed by tongue, lips, and soft palate,

and into consonants by decided actions of the same organs. Compare voice thus changed to a stream of water lazily moving amid green banks, now cutting its way through rock, broken into rapids or plunged over a precipice. The smooth running is like the vowels formed by open positions molding a steady current of voice; the breaks and plunges like the consonants formed by actions producing friction or even obstructing the breath momentarily. Vowels are the life of speech; in them lies expressive voice. The consonants are the receptacles giving temporary limits to the vocalized breath. Thus the secret of agreeable voices among the deaf is instruction based on a realization that all useful exercises in vocal culture should be founded upon perfect action of the edges of the glottis. This assured, vowels and consonants combined, forming words, may be learned as rapidly as they can be memorized. The hearing child has listened months before attempting to talk, gradually gaining confidence to use his own organs, and as nearly as possible imitating the sounds about him. Very crude are his first efforts, differing widely from his speech model. Yet no one doubts his ultimate success. Let the same confidence be manifested with the deaf child in his first lessons. Care in securing correct positions for sounds brings out lines of beauty in his face, previously disfigured by unpleasant and unnecessary movements.

How is the pupil to know the meaning of the words he learns? It is necessary to explain by the natural signs he employs; consequently his first spoken and written words must be equivalents of the same objects he has designated by a gesture, of the daily actions about him, of the qualities he has appreciated by taste, touch, and smell. Single words thus become intelligible to him. He drops the sign and speaks; his vocabulary constantly enlarges. Now a new difficulty presents itself. The grouping of words, the forming of phrase and sentence, he has no knowledge of; moreover, when grouped he does not grasp the shades of meaning thus conveyed to the hearing person. He is likely to say "Sugar like," to express his fondness for the sweet; "Horse car go" to him means "I will go in a horse car." He has no use for *a*, *an*, and *the*, is contemptuous of the changes in tense, and is baffled by idioms. No one can realize without experience the need of patience and ingenuity in the teacher who imparts language to the deaf child; no one can have sufficient of these qualities who does not strive to keep in mind the pupil's limited range and thus bear with his ignorance. The hearing person studying a foreign tongue has his own language to help him. Grammar can be remembered because similar or dissimilar to his own; arrangement of words, by resemblance or want of resemblance to the forms in his daily use. Nothing of the kind is present to aid the child born

deaf; he knows no reason why words should be arranged in certain orders. Day by day the same forms are repeated until, brought into play on every appropriate occasion, they are used spontaneously. Fortunately, the scholar does not know what is before him. Ignorant of the amount he is to learn, he absorbs his daily allowance of language, his ideas expanding, and his mind unfolding. All is delightful to him. It is the teacher who feels the great work to accomplish. Various studies can be taken up by the pupil after he has secured some hold of language and his education can be made identical with that of a hearing student. There are no limits for him but his inclinations or circumstances.

A large number of the deaf were not born in their present condition; statistics prove that many have lost hearing by disease or accident after learning to speak in the natural way. If this should occur when two or three years of age, or when even somewhat older, and no educative means are employed immediately, the speech becomes impaired in a short time. Should the child be ten or more years old, he retains his articulation fairly well, but in common with those younger, the voice rapidly acquires unpleasant characteristics. Such children in former years were silenced in the institutions. Their knowledge of speech and remembrance of forms of expression in language develop into a great advantage over those of the same age who never heard. The difference is inestimable. There is far less chance for misunderstandings, less mystery about ordinary matters; the mind is older. The impaired speech may be corrected, the voice brought under control, and instruction in speech-reading imparted at once.

Formerly the ability to understand what is said by movements in the face was called lip-reading; the term is unsatisfactory, for more than the lips must be watched. Of late this accomplishment has received the name of speech-reading. It is an ability to follow the varying expressions in the face as quickly as they appear, and thus to convey thought through the medium of the eye instead of by the hearing. Persons reading the above will look up at some one present, and after watching the face awhile will wonder how it is possible for any being to follow those movements and understand speech thereby. They attempt too much at once. Preliminary steps must be taken. The little child just beginning to read can not scan a page quickly. Success in speech-reading means an education of the eye secured by practice. Its attainment by the child born deaf grows with his knowledge of spoken language; the child who has lost hearing after having learned speech naturally, advances in ability to understand others in proportion to his dependence upon that method of communication. The wonderful organ which gives

us so much happiness, and which we find early in life carries messages to the brain in behalf of some sense lying dormant, must concentrate its gaze upon a small space, the human face. The range being limited, more detail is noticeable; attention is not diverted by general movements embodying arbitrary or natural signs, to the hand and arm, or to the whole figure. There is an opportunity to increase constantly an appreciation of shades of expression just as a discernment of the nice distinctions of well-chosen words is attained. The result is, the deaf child follows in the face of a reader the details of a story with all the relish the hearing would in listening. There is no staring, simply a quiet, steady gaze. The repeating of the words seen, proves the close connection between the eye and the speech-center.

There is no doubt many children born deaf have hearing sufficient if educated to enable them to receive correct impressions through that sense, and to be in a condition similar to that of so-called hard-of-hearing persons. One reason they do not use the ear to better advantage is that they are ignorant of linguistic sounds. The adult losing his hearing power has the advantages of a full vocabulary, a knowledge of the structure of the language, and a mastery of its idioms, combined with an ability to hold conversation in his own hands; he can learn speech-reading, which with him is a high degree of expression-reading, and he need not change his vocation or pleasures, save those requiring a somewhat sensitive condition of the auditory sense. It would be far otherwise if he had to secure language with the small amount of hearing he now possesses. Many children are deaf because of a slow perception of sound, without reference to any functional disability. They must be taught to listen, for without the strain of attention the loudest noises may be unheeded. The work of opening to them an appreciation of the world of sound is called development of hearing, and is thus designated to distinguish it from improvement of hearing; the latter is an assistance to deafness arising from a diseased condition of the ears, and is rendered by various mechanical aids, such as noise, hearing tubes, and trumpets. In developing hearing, progress depends upon using the auditory sense alone. When the vision and hearing work together in aural instruction, there is an unnatural dependence of the latter upon the former, and no regard paid to the hereditary tendencies to action between ear and speech-center. The result is that the pupil seldom understands a new word unless he first sees it upon the lips. After instruction which compelled the hearing to rely upon its single efforts the various sounds of the language are appreciated immediately in any order given; as all words are but rearrangements of the same elements, new ones can be repeated as readily as familiar ones. The strain of attention being

undivided, ability to hear sounds at a longer range grows somewhat. Noise acts as an irritant in these cases instead of aiding as in deafness due to disease.

With speech and speech-reading attained, and perhaps the happy addition of some perception of sound, the deaf need not be thrown together as a class distinct from others. They may and do receive instruction in common with their hearing friends, attending leading schools and entering professional duties side by side with them. Such persons have been charged with an unwillingness to associate with the other deaf. Lack of interest in their welfare we do not believe possible, but a preference for the companionship of the hearing proves the existence of a satisfying method of communication. All are easily influenced by surroundings, and if deprived of any particular sense, especially so. The deaf need every advantage possible, and not the least of them should be adjudged daily intercourse with the most evenly balanced characters, persons possessing a normal development of all the senses.

LOGICAL METHOD IN BIOLOGY.

By FRANK CRAMER.

THE logical processes involved in scientific reasoning are the same in kind as those used in the everyday life of the masses. The difference between the two lies in the clearer recognition of the processes and their importance in the scientific field. There is nothing like exactness in the applied logic of everyday life, and the reasoning of science is superior to the "common sense" of mankind only in being more exact. In science the comparatively little work that survives and does not have to be done over and over owes its superiority to this same exactness. Science has no peculiar method of its own either of discovering facts or of treating them.

Scientific students spend little time on the consideration of logical processes, because the mind follows them instinctively; and the study of them, for practical purposes, seems to be superfluous. But apart from the fact that they present a set of phenomena as worthy of scientific treatment as the phenomena of light or of the molluscan nervous system, it is important to consider them because of their direct bearing on every department of science. Even the best established sciences have reached their present states by successive approximations toward exactness, by the gradual elimination of errors of both fact and method; and even the novice knows that the degree of confidence placed in the statements of fact of a

scientist by his contemporaries or succeeding generations depends directly on their confidence in his method. The history of any biological problem will furnish material for a comparison of methods. The present state of the problem will be found to owe its superiority over any earlier stage not simply to the greater number of facts that can be brought to bear upon its solution, but chiefly to more exhaustive methods for the discovery of new facts and interpretation of old ones.

There are comparatively few models that will serve as illustrations of the applied logic of the sciences, or of a sound and complete scientific method. Apart from quantitative exactness, the problems of biology can be given the same rigid application of logical principles as any other science; and in recent years much progress has been made toward giving numerical expression to both facts and laws in biology. The two following examples of scientific method—the one from experimental physiology, and the other from invertebrate morphology—show themselves, on analysis, to be models of vigorous generalization and deductive inference, prompt verification, reinterpretation of old facts, explanations of old contradictions, and removal of old obstacles to a clear understanding of the matters in question.

Fifty years ago Arnold discovered that the iris of the eel's eye contracts, producing contraction of the pupil, on being exposed to light after the eye is cut out of the head, and even when the anterior part with the iris is separated from the posterior part of the eye; but that when the outer or ciliary rim of the iris is cut away no reaction follows. It seemed to be conclusively proved that in the production of the phenomenon light acts directly on the ciliary part of the iris. A few years later Brown-Séquard discovered the same reaction in the frog's eye, and inferred that the light acts directly on the muscle elements of the iris. This inference he left entirely without verification, and even asked himself, without trying to answer, the question why, if light acts directly on the muscle fibers of the iris, it does not act thus on the other muscles of the body. In 1854–'55 Budge, after apparently exhaustive experiments, denied that the pupil of the excised eye contracts when light falls on the iris and not on the retina. In 1859 Müller proved that light acts directly not only on the outer rim of the iris, but more intensely on the inner or pupillary part. After a lull of twenty years in the dispute, Edgren proved that after destruction of the retina there is no reaction at all, and that therefore light does not act directly on the iris. The only fact that remained undisputed in this strife of fifty years was that the pupil of the excised but otherwise unmutilated eye of frogs and eels contracts when the eye is exposed to the light. It was still unproved whether the phenomenon is due to an intraocular reflex

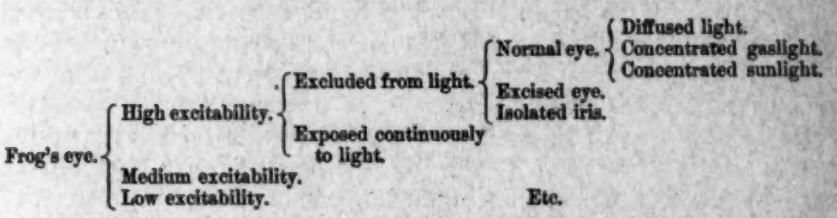
which involves the retina or to direct action of light on the iris. The latter view was the favorite one, but no efforts were made to characterize the elements of the iris on which the light acts, and so to clear up the physiological conditions of the phenomenon.

"Stick to the facts!" impetuously shriek many biologists when some luckless fellow insists that scientific method, with the principles of logic at its foundation, requires careful and incessant attention in biological investigation. In this case the sequel shows that there can be no doubt of the truth of any of the statements made during the whole fifty years. But vociferous discussion could not remove the contradictions, and experiment only multiplied them. Confusion is as consistent with facts as harmony is. It was the lack of a clear logical analysis of all the conditions of the problem that led to the contradictions. Nothing was demonstrated until these were removed, and it is an important fact that they were finally removed, not by disputing them, but by reproducing the conditions of the contradictory experiments and incorporating the contradictions themselves into the final solution of the problem.

Steinach,* by his recent experiments, demonstrated that the sensitiveness of the iris varies immensely in different individuals of the same species; that the iris of frogs, kept for days in glass cases, does not respond at all to alternate shading and exposure to diffused daylight, but slightly to concentrated gaslight, and gives a regular reaction of appreciable amount only on exposure to concentrated sunlight; that when frogs are kept for a long time in the dark the iris responds promptly to diffused daylight; but if, after the light has produced contraction of the pupil, the frog, instead of being put back in the dark, is left exposed to the light, the pupil gradually dilates in spite of the light, and after some hours acquires a state of comparative insensibility, so that moderate changes in the light produce no changes at all in the iris; and that the difference in pupillary reaction between frogs kept in the dark and frogs exposed continuously to light is greater in the excised than in the normal eye, greater still when the iris is isolated from the rest of the eye, and that, while in frogs of medium excitability of iris the isolated eye still responds to light after shading, the iris, when separated from the rest of the eye, no longer responds even to the strongest light. One would think that at least some of these preliminary conditions of success would have thrust themselves upon the attention of the earlier investigators if they were not altogether lacking in the qualifications of true scientists. They were probably no more lacking in analytical

* Investigations on the Comparative Physiology of the Iris. II. Pflüger's Archiv für Physiologie, vol. lii.

power than any other set of investigators, but they had certainly not made the most of it. Steinach exhausted the conditions by taking into account, one at a time, the different degrees of inherent excitability, effect of exposure to and exclusion from light, and the reactions of the normal eye, the excised eye, and the isolated iris, against the different degrees of light, thus:



These do not include all the conditions which he detected, but they are sufficient to indicate the difference between his method and that of his predecessors. The modifying conditions were not discovered in the order in which they appear in the table, but tabulation shows very quickly whether or not they have been exhausted.

When all the favorable conditions were combined there invariably resulted a characteristic contraction of the pupil, on exposure to light, whether the object experimented on was the normal eye, the excised eye, the isolated iris, or the isolated iris deprived of its ciliary rim. In other words, the contraction of the pupil in the excised eye of fishes and amphibia does not depend on an intraocular reflex involving the retina, but on the direct influence of light on one or more of the elements of the inner or pupillary part of the iris. It had been suggested that the phenomenon was due to the action of light on the endings of the nerve fibers in the sphincter muscle of the iris. Steinach removed this suggestion from the group of remaining possibilities by paralyzing the nerves of one eye of an animal with atropine and leaving the other normal, and showing by comparative tests that the two eyes continue to act alike. He showed by a special experiment that the posterior pigment layer of the iris has nothing to do with its contraction. The branched or stellate pigment-cells—the chromatophores—in the front part of the iris were possible factors in the problem. They were known to undergo changes due to the action of light. Light causes a redistribution of the pigment within the cell, causing it to collect at the center. When the eye of an animal which has been kept in the dark is alternately shaded and exposed to the light, there follow a prompt alternate dilatation and contraction of the pupil. This process can be carried on for some time before there is any visible change in the chromatophores; at the end of half an hour or more the chro-

matophores are "contracted," but the pupil contracts and dilates as before. Therefore the contraction of the iris is independent of the changes in the chromatophores.

At this point physiological experiment had to be abandoned, and it would have been extremely comfortable for Steinach to do as one of his predecessors had done—ride the rest of the way on a cantering hypothesis; but he appealed to histology. In his effort to determine in what other parts of the iris there was pigment, through which the light must produce its effect, he found that his judgment was confused by particles of pigment from the posterior layer, which were scattered at random over his histological preparations. This difficulty was obviated by removing the posterior layer of pigment before making the sections. After taking this precaution he showed that there is no ordinary pigment in the stroma of the iris; neither are there any ordinary smooth muscle fibers like those in the iris of the higher vertebrates. He found the sphincter muscle of the iris composed of spindle-shaped *pigmented* cells. That these are really muscle fibers he proved by their form, size, characteristic fibrillar structure, and function. It was impossible to observe directly the contraction of these fibers; he adopted the indirect method of killing the iris in the relaxed and in the contracted states and observing the condition of the fibers in each. In the former they were slender and narrow, in the latter shorter and thicker. The ciliary muscle fibers are not pigmented, and this accounts for their being indifferent to the light. His general conclusion is that light produces contraction of the isolated fish and amphibian iris by acting directly on the fibers of the sphincter muscle through their pigment.

The striking characteristic of this investigation is the exhaustive consideration and removal of alternative beliefs. His final conclusion is only an inference, and derives its "certainty" from the fact that it is the only belief that is left. In its relation to this conclusion the evidence is circumstantial. If now the reaction of the pigment and fibers could be directly observed, Steinach's conclusion would be set down as a verified prediction. Though unverified, it is unhesitatingly accepted, like so much of our "knowledge," as an important truth; for most minds its verification would add little or nothing to its certainty, and would even deprive it of some of its interest. This inferential knowledge forms a large part of scientific truth, and other instances of it will appear in the following example of method in morphology.

Various ciliated organs of unknown function in different mollusks had never been brought under the yoke of homology. One of the most decisive tests in morphology for the determination

of homology is the mode of innervation of an organ. Spengel* reasoned that the homologies of these organs could be best established by a comparative study of their modes of innervation—in other words, by discovering their relations to other organs known to be correlated in definite ways among themselves. In this way he succeeded in proving their morphological identity, although the belief that they are olfactory organs is based simply on the morphological fact that they invariably occupy a certain position in relation to the respiratory organs, and not on any physiological data.

He demonstrated the general occurrence of this particular kind of organ in the prosobranch gastropods, inferred that it ought to occur among the opisthobranchs, and succeeded in demonstrating its presence in the division of tectibranchs. He had already in his possession the hypothesis that the organ is one belonging to the mollusca as a whole and drew from it the deduction that it ought to be present in the lamellibranchs, among which it had not been hitherto known. He said: "The position in which such a one would have to be sought was clearly enough indicated to me by my observations on the gastropods. It would have to be in the neighborhood of one of the ganglia of the visceral commissure." Trusting this definite anticipation, he looked for the olfactory organ and found it in *Arca Noæ*, the first mussel he opened for the purpose. In this species the organ is characterized by pigment, which made its recognition easy. In other species that he examined the pigment is absent, and had he first opened one of these, he might have had a long and possibly fruitless hunt for the organ. This well illustrates how important a part chance frequently plays even in deductive investigation. It is interesting to note how the deduction might have remained unverified and possibly have been adandoned and yet have been a true one.

The organ typically consists of thickened epithelium innervated from a ganglion underlying it. Theory required the presence of a ganglion under the olfactory organ of lamellibranchs, but there was apparently only a strong nerve, which had hitherto been universally interpreted as the "gill nerve." Histological examination proved it to be an elongated ganglion inserted on the nerve between its origin and its ending in the gill. Here again, a deduction led to a discovery and the correction of what had seemed for years to be a settled fact.

Spengel had shown, in his study of other groups, that the nerve on which the olfactory ganglion lies arises from the vis-

* Die Geruchsorgane und das Nervensystem der Mollusken. Zeitschrift für wissenschaftliche Zoologie (April 22, 1881), vol. xxxv, pp. 333–383.

ceral ganglia inserted in the visceral commissure, and not from the pleural ganglia. With one stroke of deduction he swept away a whole brood of old views. He reasoned that the parieto-splanchnic ganglia of lamellibranchs, from which this nerve arises, must on account of this very fact be the visceral ganglia, and not what they had been universally assumed to be—the homologues of the pleural ganglia of gastropods. The old view necessitated the belief that the renal, reproductive organs, etc., of lamellibranchs are innervated from the pleural ganglia, and that the foot with all its accessories is included within the œsophageal ring of ganglia; whereas in other mollusks the renal, reproductive, and associated organs are innervated from the visceral ganglia and the foot lies outside of the œsophageal ring. If the parieto-splanchnic ganglia of lamellibranchs are homologous with the visceral ganglia of other mollusca all the above-mentioned organs hold the same relations in lamellibranchs as in the other groups. This reinterpretation of so many known facts harmonizes the lamellibranch type completely with that of the general molluscan type and marks a distinct step in the progress of molluscan morphology. He pursued a similar though less complete course with the cephalopods.

By this method of morphological reasoning, accompanied and corroborated or corrected at every step by morphological investigation, a heterogeneous mass of facts was bound together under the principle of homology, and many new ones were discovered that would not have been brought into notice in any other way. Indeed, the principle of homology, together with the principle on which it depends, the correlation of organs, furnishes a basis without which it would be nearly impossible to make intelligent search for new facts. Incessant use is made of the general logical principle that things that are similar in some respects, are likely to prove similar in other and unknown respects, and that things similar in many respects are likely to prove similar in most or all respects, in anticipating biological facts. It is well known that many of the facts of greatest theoretical importance in biology have been overlooked until hypothesis pointed them out. Yet this power of prevision is one of the most dangerous of pitfalls. No rule can be laid down for the use of the principle, because there is none. There is a general precaution to be observed: similarity in a few respects is no warrant for inferring similarity in many respects, much less all respects. Too many biologists, among them some of the most eminent, seem to have a wrong conception of the function of this logical principle. Scholastic methods are the favorite butt of scientific wit, but that notorious old tendency to speculate without due regard to facts is not dead but only facing in another direction. The stupid blunders and

worthless "results" due to it are charged up against the far-reaching logical principle itself and have given rise to a counter tendency that is no more creditable. The old cry, "Stick to the facts!" simply means that the danger of going wrong increases very rapidly as one passes by inference beyond known facts, especially when these are few in number. Perhaps the greatest boon that could fall to biological science would be such a thorough study of the history of the science by its own votaries that they would learn beyond the power of forgetting the fact that speculation alone is worse than useless, and that reasoning with verification is indispensable.

INVENTION AND INDUSTRY AT THE SOUTH.

By BARTON H. WISE.

THE antagonism between the plantation interest on the one hand, and commerce and manufacturing on the other, was pointed out at an early period of our history. The institution of negro slave labor repelled white labor and immigration from the South; and while the North received continuous waves of population, and the growth of commerce and manufacturing caused cities to spring up in every direction, the South remained a sparsely settled section, almost purely agricultural. These conditions have been attributed in part to climatic influences, but this theory hardly holds when we reflect that what we call the South is not only part of the Northern continent and in the temperate zone, but that its southernmost point is seventeen hundred miles north of the equator. So much did the increase of population in the South, however, lag behind that of the North, that in 1850 there were in the former only 18·93 inhabitants to the square mile, to 45·8 in the latter. Not only could capital at the South be more profitably invested in lands and negroes than in manufacturing, but in addition efforts at establishing manufacturing plants were unsuccessful, as negro labor was not suited to it.

In considering the subject of inventions at the South, we can not afford to overlook these facts, nor can we overestimate the depressing effect that negro labor was calculated to produce, though indirectly, upon the inventive faculties of the people. In the North every circumstance tended toward the encouragement of manufacturing, and among a people who, as a consequence, were accustomed to the use of machinery of all sorts, the inventive faculties were stimulated to their utmost.

In the South these conditions were exactly reversed, and nothing tended to the growth of manufacturing or of an urban popu-

lation. If we except Baltimore, Louisville, and St. Louis, neither one of which is an exclusively Southern city, New Orleans remains even to-day as the only city in the South of over one hundred thousand inhabitants. Neither Richmond, Atlanta, Charleston, Memphis, nor Nashville has a white population of fifty thousand. With these various conditions borne in mind, it is not strange that the talent of the Southern people was exercised in other directions than those of inventions.

The military qualities of Southerners have been demonstrated in every war in which the United States was engaged; and the leadership in the Revolution, the second war with England, the war with Mexico, and on the Confederate side during the civil war, fell to the part of Southern men. Even on the Northern side during the last-named contest numbers of the foremost soldiers and sailors were men of Southern birth, prominent among whom may be mentioned Thomas, Ord, Fremont, Newton, and Farragut. Abraham Lincoln, the head of the civil administration during the same period, was a born Southerner, and Grant was of Southern extraction. In statesmanship the South had held the highest rank always, and under Southern leadership all the additions to the national domain were made. His English ancestry, the republican form of government under which he lived, the call of a new country for political thinkers during its formative period, the passion for governing engendered by the ownership of slaves, and lastly the long antislavery agitation which saturated the atmosphere with politics, all contributed to cause the ambitious Southerner of the past to drift into public life. The descendants of the Jamestown colonists inherited the Anglo-Saxon spirit of adventure which characterized their ancestors, and it is not strange that Virginia led the rest of the States of the Union in the number of her pioneers who settled the West and Southwest. While all this is true, the talents of the South were largely confined to these channels when exerted at all, and the ability of the North, as has been said of it, "sought expression in a wider range of subjects than that of the South." Conditions at the South were not favorable to the growth of literature, art, or invention, and there being no cities of large size, there were hence no common centers of activity, where either literary workers, artists, or scientists could be sure of employment, and be in contact with sympathetic minds following kindred pursuits. Edgar Allan Poe toiled away at Richmond as editor of the Southern Literary Messenger, but was compelled finally to drift northward to maintain a livelihood. William Gilmore Simms, the only man of note in the South, besides Poe, who followed literature as a profession, plodded along in South Carolina among a people who afforded him little encouragement, and his numerous efforts to

found a literary magazine in Charleston all met with failure, despite the fact that an unusually cultivated society dwelt in that city. Washington Allston, after finishing his art studies in Europe, located in Boston, which was able to hold out to him greater inducements than the little city of Charleston, the metropolis of his native State. Gottschalk, the composer, whose dreamy, sensuous music suggests his Southern birth, after finishing his musical course in Paris, made his *début* there, and died finally in Brazil, spending but little time in New Orleans. Audubon, with his dog and gun, and his pencil and drawing pad, searched the woods and bayous of his native Louisiana for his specimens of birds and natural history that were to win for him the name of the greatest naturalist of the New World. But he labored under adverse conditions, and he had to canvass the large cities of Europe for subscribers to enable him to publish his book on the birds of America, the greatest ornithological work ever undertaken. This he brought out at New York in 1830, with plates containing over one thousand birds of life size, and Cuvier pronounced it "the most magnificent monument that Art has yet raised to Nature."

In the Constitutional Convention of 1787, James Madison, of Virginia, and Charles Pinckney, of South Carolina, proposed the clause protecting authors and inventors, which was the foundation of our copyright and patent-right system. The Patent Office was organized and placed on a firm basis largely through the efforts of Jefferson, who is credited with being its founder, and later on it was reorganized and perfected during Jackson's administration. Jefferson was himself an inventor, being the first American to study and improve the plow. The year 1789 is memorable as the date upon which Rumsey, a Maryland machinist, then living in Virginia, launched his boat upon the Potomac, propelled by steam, Fitch performing a similar experiment upon the Delaware about the same time. Later on, in 1792, Rumsey went to England and made a successful trial trip on the Thames. This same year Eli Whitney, a young New-Englander, invented his famous cotton gin, that may be said to have revolutionized the history of the South and the Union. As an illustration of the scarcity of manufacturing and mechanical establishments in the South at that date, it may be mentioned that Whitney had to draw himself the iron wire he needed and make his own iron tools at the plantation of Mrs. Greene, the wife of General Nathanael Greene, on the Savannah River, where he was residing. It is a notable circumstance that the first canal in America of any consequence, the first telegraph line, and the first railway propelled by steam were all constructed in the South, and the first steamship to cross the Atlantic embarked from a Southern port. The first canal of im-

portance was the James River and Kanawha, which began at Richmond, and was designed to connect the Chesapeake Bay with the Ohio River. It was proposed by Washington and begun in 1785, and afterward carried as far westward as Buchanan in Virginia. During the year 1818 leading merchants of Savannah, Ga., had constructed, through the advice of Captain Moses Rogers, of that city, a combination steam and sailing vessel to run between Savannah and Liverpool. The machinery and engine were built in New York by Daniel Dod, a Virginian, who had moved to that city, and on the 20th of May, 1819, this vessel, which was christened the Savannah, steamed out of the Savannah River for Liverpool, making the first transatlantic trip by a steam vessel in twenty-two days. It created a great sensation in England, and "the people crowded the Mersey's banks filled with surprise and admiration when she entered the harbor of Liverpool under bare poles, belching forth smoke and fire, yet uninjured." From Liverpool the Savannah steamed to St. Petersburg, where it aroused the curiosity of the Czar, and attracted great attention. The log book and cylinder of the vessel are at present on exhibition in London. Charleston secured in 1827 the first railway charter granted in the South for the South Carolina Railroad; and when a few years later it was completed to a point on the Savannah River, opposite Augusta, called Hamburg, it was one hundred and thirty-six miles in length, and the longest line of railway at that time in the world. The directors of this road determined as early as November, 1829, to make steam the sole motive power, which had not then been adopted elsewhere in America, and the first locomotive constructed in the United States, which was called the "Best Friend," was planned for this road by E. L. Miller, of Charleston. The South Carolina Railroad was the first steam railway to carry the United States mail, and the system of double-truck running gear, including the application of pedestals to the springs, which was later on copied by all the railroads, was instituted by Horatio Allen, their engineer. Strenuous efforts were made in the South in the way of railway construction, but in a sparsely settled section the rate of increased mileage naturally fell far short of that in the more densely populated North. The inscription on the bust of Robert Y. Hayne, in Charleston, records that "his last public service was his effort to open direct communication with the vast interior of our continent." "Next to the Christian religion," said Hayne, "I know of nothing to be compared with the influence of a free social and commercial intercourse in softening asperities, extending knowledge, and promoting human happiness." He might at this particular period have named one thing more potent even than railways in uniting the different sections of the country—namely, the

doing away with the system of African slavery, for which, though the South was not responsible, it having been fastened upon her by the greed of England and New England, yet which blighted her industries and made her isolated in her modes of thought and out of touch with the world at large.

Despite the fact that the people of the South were but little engaged in scientific or mechanical pursuits, and that their intellectual energies have for the most part been absorbed with other thoughts, yet many notable inventions and contributions to science have been made by Southern men. Cyrus H. McCormick, a native of Rockbridge County, Va., and the inventor of various agricultural implements, among them his famous reaper, received the thanks of the French Academy of Sciences for having done more for the cause of agriculture than any other man living. "Owing to Mr. McCormick's invention," said William H. Seward in 1860, "the line of civilization moves westward thirty miles each year." Richard J. Gatling, of Hertford County, N. C., devised various machines and the "Gatling gun," now an arm of the United States service and adopted by foreign governments as well. Both McCormick and Gatling moved West—the former to Chicago and the latter to St. Louis—the country districts of Virginia and North Carolina affording them poor fields for their endeavors. Henry J. Rogers, a Baltimorean, was the practical adviser and assistant of Morse in the construction of the first telegraph line in the United States, which was built in 1844 between Washington and Baltimore. He was the superintendent of it and made many improvements in it, and was the inventor of several telegraphic instruments. Rogers also devised the first system of pyrotechnic signals in the United States and the one by means of flags that was adopted by the navy in 1846. The author of international fog signals was Samuel P. Griffin, of Georgia; and the inventor of the first complete system of ciphers used by the associated press was Dr. Alexander Jones, of North Carolina. The name of Maury stands above that of every other Southerner, if not of every American, in his contributions to science. Maury's writings demonstrated that meteorology could be raised to the certainty of a science, and Humboldt credited him with being its founder. He was also the first to give a complete description of the Gulf Stream and to mark out specific routes to be followed in crossing the ocean, which won for him the name of the "pathfinder of the seas." In addition to these he founded the method of deep-sea sounding, and his letters to Cyrus W. Field, now in the National Observatory at Washington, prove him to have been the first to suggest the idea of connection between the two continents by means of a cable on the bed of the ocean, and the present cable was laid along the lines pointed out by him. The plan of splicing the

cable in mid-ocean was devised by Dr. James C. Palmer, of Maryland.

The limits of this article do not admit of giving a list of all the Southern men who have made inventions of note. Some of them are John Lawrence Smith, of South Carolina, the celebrated mineralogist and inventor of the inverted telescope; "Sibley, of Louisiana, and his conical tent; Gibbs, of Virginia, and his sewing machine; Janney, of Virginia, and his car coupler; Gorrie, of Louisiana, and his ice machine; McComb, of Louisiana, and his 'arrow' cotton tie; Gaynor, of Kentucky, and his fire telegraph; Stone, of Missouri, and his grain roller mill; Remberts, of Texas, with his roller cotton compress; Clarke, of Texas, with his envelope machine, and Campbell, with his cotton picker; Bonsack, of Virginia, with his cigarette machine; Coffee, of Virginia, with his tobacco stemmer; Stevens, of Florida, with his fruit wrapper; Law, of Georgia, with his cotton planter; Avery, of Kentucky, with his plow sulky; Watt and Starke, of Virginia, with their plows; McDonald, of our own day, with his fish ladders and hatcheries, filling our streams with fish." Henry Draper, a Virginian by birth, who removed to New York, made what has been called "the most original discovery ever made in physical science by an American." He was an authority upon telescopic work, and his experiments in his specialty of celestial photography led to the discovery of oxygen in the sun by this means and a new theory of the solar spectrum.

In the practice of medicine the Southern physician was under the disadvantage of having thinly populated country districts as the field of his labors, and he lacked the benefits of association and co-operation with those of his own calling that a city physician enjoys. But his isolated situation, as has been said of him, often stimulated boldness of thought and original investigation. Ephraim McDowell, M. D., a native of Rockbridge County, Va., and who had moved to the little village of Danville, Ky., performed here in 1809 the first operation on record for the extirpation of the ovary—an announcement received with incredulity in Europe, but the truth of which was established, and which won for him the title of the "father of ovariotomy." Crawford W. Long, M. D., a Georgian, performed in Jefferson County, his State, on March 30, 1842, the first surgical operation on record, with the patient in a state of anæsthesia, which was produced by the inhalation of sulphuric ether. Of a like class of men was J. Marion Sims, M. D., of Alabama, the pioneer in gynæcology and abdominal surgery. The eminent surgeon, Dr. Hunter McGuire, whose position as Medical Director of Stonewall Jackson's corps, Army of Northern Virginia, gave him exceptional opportunities of information, said of the surgeon in the Confederate army: "His

scanty supply of medicines and hospital stores made him fertile in expedients of every kind. I have seen him search field and forest for plants and flowers whose medicinal virtues he understood and could use. The pliant bark of a tree made for him a good tourniquet; the piece of a green persimmon, a styptic; a knitting needle, with its point sharply bent, a tenaculum, and a penknife in his hand, a scalpel and bistoury. I have seen him break off one prong of a common table fork, bend the point of the other prong, and with it elevate the bone in depressed fracture of the skull and save life. Long before he knew the use of the porcelain-tipped probe for finding bullets I have seen him use a piece of soft pine wood and bring it out of the wound marked by the leaden ball. Years before we were formally told of Nélaton's method of inverting the body in chloroform narcosis, I have seen it practiced by the Confederate surgeon. Many a time I have seen the foot of the operating table raised to let the blood go by gravitation to the patient's head when death from chloroform was imminent, and I will add that in the corps to which I was attached chloroform was given over twenty-eight thousand times, and no death was ever ascribed to its use." The talents which the stern necessities of war called forth in medical science were exhibited in every other department by the Southern people. It has been said that "one of the compensations of war is a swift ensuing excitation of the mental faculties," and in this instance it would seem to have been so. The outbreak of the civil war in 1861 found the seceding States with a population of eight millions, about one half of whom were negro slaves, as against twenty-four millions in the non-seceding States. The disparity in population between the two sections, however, great as it was, was not greater than that of their equipment in the implements of warfare. A widely separated, almost exclusively agricultural people, without manufactories or skilled labor, were to contend with a people accustomed to the handling of machinery of all sorts, operated by the highest class of trained mechanics, and in whom the inventive faculties had been developed to their utmost. One of the greatest curses of negro slavery was not only that it was in itself an inefficient labor for the higher classes of work, but it also served to drive out white labor of the better sort, which invariably shunned the black districts. A striking instance of the scarcity of skilled labor in the South was furnished in the matter of making gunpowder with which to carry on the war. In the spring of 1861 Mr. Davis authorized Colonel George W. Rains to undertake the construction of powder works for the Confederacy. These mills, begun in September of that year at Augusta, Ga., were finished the following April. For the first year of the war the Confederates were almost entirely dependent upon the powder captured from

the enemy, and more than once military movements were hampered owing to the scarcity of ammunition. We have it upon the authority of Colonel Rains that "but one man—Wright—could be found in the Southern States who had seen gunpowder made by the incorporating mill, the only kind that can make it of the first quality; he had been a workman at the Waltham Abbey Government Gunpowder Works in England." During the period that the Augusta mills were in process of construction a small powder factory was run at Manchester, Tenn. The output of this was very limited, and it was conducted mostly as a school of instruction, and as soon as the Augusta works were completed the operatives and machinery were transferred there. At the same time, at a refinery in Nashville, workmen were being taught to refine saltpeter and distill charcoal. Notwithstanding these methods of obtaining competent labor, it was with the greatest difficulty that a sufficient supply could be procured, and as a consequence every sort of labor-saving device possible was adopted. Among the improvements introduced by Colonel Rains in this way was a crystallizing machine of his own invention for refining saltpeter, the main constituent of gunpowder, and which has to be brought to a high state of chemical purity. By means of this machine eight or ten thousand pounds of saltpeter, used by the works daily, which had to pass through many stages and undergo much manipulation, which at first required a large force by manual labor, was prepared by two or three workmen. Other improved methods of powder-making were brought into use for the first time, and the Confederate powder works were pronounced among the finest in the world, and the London Times and other foreign papers gave lengthy and commendatory descriptions of them.

The Confederacy was furnished with one thousand three hundred and seventy-five tons of gunpowder from these works. Colonel Rains is authority for the statement that "notwithstanding the admirable serving of the heavy artillery at Fort Sumter during that engagement, it would have fallen and Charleston been captured had any but the strongest gunpowder been used. The armor of the ironclads, though constructed expressly to withstand the heaviest charges and projectiles, gave way before its propelling force." General G. J. Rains, a brother of Colonel Rains of the powder works, was the inventor of the sub-terra shells, that were first used after the battle of Williamsburg, and which proved effectual in retarding the advance of the Federal forces. At the time that McClellan was in command below Richmond, in 1862, and his vessels in James River, General Rains was placed in command of the submarine defenses by the Confederate Government. Here, opposite Drury's Bluff, the first submarine torpedo used in the war was made. This mode of defense had been previously

experimented with by the Russians in the Crimea, but it had proved ineffectual against the allied fleets. Under the spur of dire necessity the Confederates turned their attention to it, and it was brought to such a state of efficiency that Charleston, Wilmington, and Savannah maintained a successful defense till near the end of the war, despite the efforts of Dupont and Dahlgren to force an entrance through their harbors. Their destructiveness was demonstrated at many other points, and fifty-eight vessels, including ironclads, were destroyed by this means in Southern waters.

Shortly after the breaking out of the war, the naval department of the Confederacy began experiments of various sorts with floating batteries and naval rams, many of which were conducted under the supervision of Lieutenant Catesby ApR. Jones. The name of Lieutenant Jones, together with that of Lieutenant John M. Brooke, the inventor of the "Brooke gun," and deviser of the plan by which the hull of the frigate Virginia was converted into the ironclad Merrimac, deserve mention along with Maury and Buchanan, as being the men who probably did most toward rendering the naval appliances of the Confederates effective. English and French officers who witnessed the fight in Hampton Roads of March 8, 1862, when the Merrimac sunk what were then considered as among the finest war ships, remarked to a Confederate naval officer, Captain H. B. Littlepage: "We have not a war ship in our navy; a wooden ship is no longer a war ship; that fight will rebuild and remodel the navies of the world." "The British navy," says Captain Littlepage, "which cost hundreds of millions of dollars, was as effectually destroyed on that eventful 8th of March as was the noble old Cumberland, sunk to her topsail yards by the Merrimac's ram, a weapon practically unknown before. The 9th of March but emphasized the value and importance of iron-plated vessels, and illustrated two principles in the construction of war ships which must last for all time—i. e., the deflecting and turreted armors."

The Confederate Ordnance Department had at its head a highly competent officer, Colonel Gorgas, and through a system of rigid civil-service examinations a set of efficient men were obtained. In the early part of the war, before the blockade became stringent, ordnance stores were purchased in Europe, and these, with what were captured from the enemy, were used. Many instances might be cited to show the difficulties that were gone through with to supply the army, such as the making of percussion caps for the last year of the war (the Confederates being armed entirely with muzzle-loaders) out of turpentine and brandy stills gathered in North Carolina, the only copper mines in the South having fallen into the hands of the enemy. Another

illustration was the substitution of chlorate of potash and sulphuret of antimony for mercury to fill the caps, the latter not being obtainable. These and many other similar facts might be quoted to confirm the statement of Colonel William Leroy Broun, the head of the Richmond Arsenal, and at present the superintendent of the Alabama Polytechnic Institute, that "when we consider the absence of manufactories and machinery and of skilled mechanics in the South at the beginning of the war, its [the Ordnance Department] successfully furnishing ordnance supplies for so large an army during the four eventful years is a striking instance of the wonderful energy and resources and abilities of its people to overcome difficulties." We have but to look at the table of manufacturing establishments in the South at present, in comparison with past years, to realize the rapid increase in that line and the growth of skilled labor that must inevitably accompany it. From 1880 till the present there has been a wonderful forward movement. Data have not yet been collected in full by the Census Department for 1890, but the bulletins issued on the principal Southern cities all show a large increase in the number of plants of every sort, and the cities of Memphis, Nashville, New Orleans, Mobile, Charleston, Richmond, Norfolk, Savannah, Augusta, and Baltimore, all of them more than doubled, and some of them more than quadrupled the amount of capital invested in manufacturing enterprises between 1880 and 1890. Railroad mileage in the South increased from 23,811 miles in 1881 to 44,805 in 1891, and the number of cotton mills during the same period from 161 to 356. All of these facts speak for themselves, and need no comment to point out their influence upon the future. Another potent factor, in its influence in stimulating invention in the future, is the great increase in industrial and polytechnic schools in the South, and the attention now paid to the study of natural science, which was formerly neglected for the classics. As has been recently pointed out in an interesting article by Prof. Charles W. Dabney, in the early days of American history the preachers were the learned men and the leaders in educational work. Nearly all the older colleges were the offspring of the churches, and in the South this continued to be the case, not only down to the period of the war, but for a decade afterward. The University of Virginia, one of the few institutions not under church influence, was naturally the first to open advanced scientific departments. It may be mentioned also that this university was the first in the Union where the *elective* system was introduced, in contradistinction to the curricular method in vogue elsewhere. Harvard and other Northern colleges have in late years modeled their courses much after the Virginia plan. The South has also within its borders probably the first college in the

world to confer a degree upon a woman. The higher education of females was undertaken at an early date in Georgia, and the Georgia Female Institute, opened in 1839, is believed to have preceded both Oberlin and Mount Holyoke in granting degrees to women. Of late years there has been a marked improvement in the number and character of educational institutions of all sorts in the South, but the most significant change is in the number of technological schools, scarcely one of which was in existence twenty years ago. Prof. Dabney quotes the reports of the United States Bureau of Education for 1888 and 1889, which show that there were at that time "a total of twenty-eight schools, or departments of schools, giving regular instruction in science and technology, an average of over two for each State." If the list of patents taken out by residents of the different States for the past century shows that the South has been considerably behind in the race, the more recent statistics are suggestive of a different result in the near future. The following figures give the number of patents granted residents of the Southern States for the years named: 1860, 667; 1870, 1,469; 1880, 2,656; 1885, 1,633; 1890, 3,159.

If it be asked what in the future will be the effect of negro labor and the race problem on the South, the answer is that there will be no negro labor and no race problem, for the very good reason that there will be no negro there. This will doubtless strike the average reader as a bold and perhaps absurd prediction, but every circumstance points to its fulfillment. The idea is by no means new, and Jefferson, probably the profoundest political philosopher of his country, a strong opponent of slavery, and it should be added a resident of a slaveholding State, and whose knowledge of the institution was actual, not theoretical, long ago gave this as his opinion. He asserted that nothing was more certainly written in the book of fate than that the negro was to be free, and he added that it was equally certain that when free the two races would not continue to live side by side. This was also the view of Calhoun, who, while unlike Jefferson a proslavery man, held his opinion as regards the impossibility of the two races continuing together after emancipation. The industrial conditions of the South at present point clearly to the realization of these prophecies at a period not far distant. We hear and talk much of the conflict between capital and labor. We forget that the real conflict is not between capital and labor, but between labor and labor. No race has ever stood in the way of the Anglo-Saxon in his onward march, and it is not probable that the negro race, among the lowest in the scale of civilization, is to be the sole exception to that rule. As the poor white of the South, reenforced by the laborer from the North, enters more and more into the field as a competitor with the negro, the latter will meet

with an antagonist that must sooner or later press him to the wall, and in conformity to his racial instincts the African will move on farther and farther southward.

The number of farms at the South has increased rapidly since the war. This does not mean more land, but the subdivision of the larger estates of the past into smaller holdings, and an increase in the number of white yeoman farmers who do their own labor. Besides these circumstances, the census of 1890, contrary to the general idea, showed that the natural rate of increase of population among the Southern whites over the negro was almost in the ratio of two to one. The effect of this excess of white increase is apparent, and besides it is by no means probable that the white inhabitants of the South are not to be added to by large immigration from the North. The granting of the suffrage to the negro, partly through a misguided and in part a pretended friendship, will aid to further his displacement, for his aspirations as a politician have not been favorable to his success as a laborer and the betterment of his material condition. Neither the sword and bayonet nor plague and pestilence are necessary to a work of uprooting, for by a natural racial and economic law the negro will be driven out and supplanted by the white, and Louis Blanc's theory of extermination be illustrated as never before. There was a certain fitness in the emancipation proclamation being signed, when it came to be, by Abraham Lincoln, a representative of that class of Southern whites upon whom the institution of slavery had borne most hardly, and who were crowded out of the slaveholding districts. Time and the developments of the future will show more and more that in slavery the negro found his preservation, but the laboring white his curse. The historian Green tells us that after the Norman conquest there was among the English people "an immense outburst of material and intellectual activity," and that "the long mental inactivity of feudal Europe broke up like ice before a summer sun." It would be anything but correct to refer to the "mental inactivity" of the *ante-bellum* South, for in the lines that its talents were exerted it showed an ability fully equal to that of any other section, but the incubus upon its material growth, and the problems which then demanded its intellectual energies, are now in a large measure removed; and we may say of the South, as Green does of the England of King John, that it is "quickened with a new life and throbbing with a new energy." We need not fear the effects of an enervating climate or Southern sun. The upper tier of Southern States and the Southern Appalachian region form probably the best climate on the Atlantic side of the continent, and in the more Southern States, such as Alabama and Louisiana, while the summers are longer, yet the heat of the sun

is not as oppressive as in the North, though the air is as balmy as that of Italy. History does not show that a softer air and sky are less favorable to intellectual growth in any line than a more harsh and uncongenial clime. Italy is not only the land of Michael Angelo, of Raphael, and of Titian, but of Volta, Galvani, Torricelli, and Galileo as well, and the atmosphere that excites the imagination is as favorable to inventive genius, as applied to natural science or mechanics, as to painting, sculpture, or music. Of the Southern States we may say that no section of the Union gives promise of greater achievement; indeed, none is so rich in what the future has in store.

LEGAL PREVENTIVES OF ALCOHOLISM.*

By M. J. BERGERON.

WE have met to study together the means of combating alcoholism, to which we can not refuse the well-merited title of the scourge of the nineteenth century, for it has produced and is still producing more victims than the plague and the cholera combined. We all know that it is what multiplies assassinations and suicides, populates insane asylums, crowds hospitals, and contributes to the sterilization of the race. We are not here to repeat what has been said over and over again till it has become tedious, since the days of Magnus Hus, or to indulge in sterile lamentations over the ravages of alcoholism, but to seek a remedy for the terrible evil.

I do not bring you this remedy, but come to ask for it; for I hope that this congress—more fortunate than its predecessors—may be able, if not to shape the details of a law or of measures applicable to all civilized states, at least to point out, in a more precise fashion than has hitherto been done, a way to reach most promptly and surely the end we are all aiming for. We ought then, first, to inquire into what has already been attempted in some of the states of Europe: and I shall begin with the country I know the best, France, which has not, more than the northern states, escaped the invasion of alcoholism. It is of recent origin there, it is true, but its progress has been frightfully rapid; yet it was not till after the delirium and crime of the Commune, during which it played a terrible part, that our thoughts became fixed on the study of the means of arresting the spread of the scourge.

It was toward the end of 1871 that M. Théophile Roussel pre-

* A paper read at the Fourth International Congress against the Abuse of Alcoholic Drinks, held at The Hague in August, 1893.

sented and secured the adoption by the National Assembly of a law against intoxication; and about the same time, too, the Academy of Medicine commissioned me to prepare an Advice to the People on the dangers of the abuse of alcoholic drinks; and that the lamented Lunier, seeking to carry out practically a conclusion of my Report on Vinage, organized the French Temperance Society. But the law against intoxication, executed leniently from its promulgation, soon fell into desuetude;* the Advice to the People has been a dead letter; and I am obliged to confess that the Temperance Society, which decorated me after two years of presidency of it with the title of honorary president, in spite of the zeal and talent of its general secretary, M. Motet, drags on a precarious and obscure existence, and has, I believe, accomplished to the present time nothing more than to reward a few brave men who have remained sober, without diminishing by a single individual the number of drunken men.

The state has attempted to intervene in the struggle against the progress of the evil no further than to raise the taxes on alcohol to an amount which seems exorbitant, but is still much lower than the tax the English consumer pays; but this increase has exercised no influence on the consumption, which, on the other hand, has not ceased to advance, as it has also done in England since the establishment of the new taxes.

We might apparently base great hopes on the reduction of the taxes on the substances entering into the preparation of hygienic drinks, such as coffee and tea, and of the sugar tax. Indeed, I think that these are excellent measures, and of advantage to sober persons accustomed to these salutary drinks to the exclusion of intoxicating liquors; but I hardly believe that they are of such a nature as to cause drinkers of alcohol to give up their favorite beverage, or to secure youth, workmen, or others from the attractions of the inn, where more alcohol and distilled liquors are sold than wine.

The consumer can not be induced to use coffee and tea instead of alcohol, unless he can find in those hygienic drinks the excitation which alcohol and all the mischievous preparations of which it is the base will procure for him. Now, this excitation of the brain is the source of all the harm. To beginners, who as yet use alcoholic drinks with moderation, they give the agreeable sensa-

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* In the first years following the promulgation of the law against public intoxication, there were drawn up annually from eighty thousand to ninety thousand indictments for violation; since 1885 the number of prosecutions has fallen off one half; it varies between forty-five thousand and fifty thousand; and it is to this relaxation in repression that we should attribute the diminution in the number of indictments, and not to progress in temperance, for the ravages of alcoholism keep on increasing.

tion of seeing everything on the good side, and of experiencing a momentary augmentation of strength. We should not be surprised, therefore, to find that people who have for the first time felt this sensation are tempted to seek it anew, and to ask of it continually a forgetting, even though it be only momentary, of the difficulties of life, of the fatigues of their occupation, and the illusion of a greater capacity for work which neither tea nor coffee will ever procure for them.

We might, therefore, regard the reduction of the duties on wines as a suitable measure for diminishing the ravages of alcoholism. I believe, in fact, that even the abuse of wine, supposing it to be pure from all addition of alcohol, is not so injurious as even the moderate use of alcoholic drinks; but, with wine the drinker will obtain the excitation he seeks only by drinking considerable quantities, while a small portion of alcohol suffices for producing, at less expense, the desired effect.

Rational as these different measures may be, I consider them powerless so long as the drinker of alcohol can find everywhere, at every hour and every step, a shop for the sale of his favorite beverage. To suppose them efficacious in the present state of affairs—that is, with unlimited liberty to every one to open a shop—is to expect on the part of the drinker, and especially for one to whom life is a hard trial, a moral constraint and an effort of reason of which he is incapable, at least in many mediums and under many social conditions. For this reason, without discrediting the results which may be reached by adjustment of taxation, I am still convinced that the surest means of restraining the drinker swiftly descending into alcoholism, and of preventing the fall of those as yet unacquainted with the mischievous seductions of the infirmity, is, first of all, to protect him against the temptation; then, if the measures which I shall call prophylactic fail, to inflict a punishment upon him proportionate to the gravity of his offense; and I am obliged to acknowledge with regret that nothing serious has been as yet done in France in either of these directions. Norwegian legislation, on the contrary, appears to me to be admirably conceived from the point of view of prophylactics. In Norway, whoever wishes to open a liquor shop must ask permission from the municipality, which may refuse it. In order to take away all retroactive effect, they had, in the beginning, to exempt dealers already established from the necessity of obtaining a permit; but when the successive extinctions did not diminish the number of shops fast enough, the municipalities were authorized to expropriate, on condition of indemnifying them, a suitable number of the existing shops.

This is evidently a measure which might give salutary results in every country, provided the municipalities are sufficiently im-

pressed with the importance of the object sought, and comprehend that it is nothing less than to save the country from a serious peril.

A priori, we might hope much from the Gothenburg system, which consists chiefly in intrusting the management of the public houses to temperance men, who, in selling alcoholic drinks, the use of which it is very hard to suppress completely in northern countries, and giving them to consumers only in proportions compatible with the maintenance of health, should make every endeavor especially to induce their customers to prefer tea and coffee. But I do not know whether this system has been greatly extended or has been generalized, with good results. I believe, however, that the most radical measure, and the one that has been most efficacious, is that of giving to municipal councils the right of absolutely prohibiting the sale of spirituous liquors. Where this system is in operation we may sometimes go considerable distances, it is said, without finding a single liquor shop. If a less restrictive rule is adopted, the prohibition of the sale on religious holidays, and before eight o'clock in the morning and after six in the evening on working days, can not but contribute to the success of a campaign like that so intelligently undertaken and energetically conducted by Norway. Whatever part may have been contributed by each of these measures to the realized results, it is a fact testifying eloquently to their efficiency that in that country the consumption of alcohol, which was in 1843 eight litres per inhabitant, has fallen to 1·70 litre, while in France it is now four litres, having risen, since 1850, from only 1·45 litre. In Germany the taxes on liquors are light, although they have recently been quadrupled; but increase of taxes has not brought about any reduction in consumption, which is 4·5 litres per inhabitant. On the other hand, it should not be forgotten that no serious effort has been made there until recently to contend against the scourge. It is announced, however, that the Government, struck with the dangers threatening the people by the increase of alcoholism, is preparing new legislation which will apply to sellers and consumers. For dealers it requires a license which will be granted only when competent authorities are satisfied of the need of the shop, or are given incontestable moral guarantees; prohibits their selling on credit, declaring all debts contracted for liquors null; forbids sales to children less than thirteen years old and to in-intoxicated persons; and makes them responsible for disorders occurring in their establishments, with penalties consisting of fines or imprisonment for not more than four weeks.

The new system affects consumers through the measures it provides for the protection of society and families against injury from drunkards. The principal of these measures are, besides the

pecuniary punishment for the public scandal of a man in a state of intoxication, removal to a special establishment for victims of alcoholism, and putting the drunkard under guard if he shows himself unfit to manage his affairs, or misbehaves in a way to imperil the safety of third persons. While the dealers do not accept with good grace a measure which will so greatly compromise their interests, and are petitioning against it, the women see in it a hope for the salvation of their families, and are also circulating petitions in which it is declared that when the free use of alcoholic drinks, often adulterated, is energetically prevented, prosperity will return to the homes of numerous workmen. The women are right this time, and I would sign their petition with both hands; and I wish that our French women might form a league for the same purpose, which might perhaps awaken our legislators from their indifference.

Austria has increased the tax on intoxicating drinks, and has endeavored to limit the number of public houses; but I have no documents at hand from which I can learn the effect of these measures. Belgium has not adopted any restrictive law except one against intoxication, and the consumption of liquors there has risen to twelve litres per inhabitant, while public houses have multiplied till there is now an average of one for every forty-three inhabitants, and in some places one for every twenty-four, or for every five or six adults. In the grand duchy of Luxemburg the number of drinking shops has become so excessive that a law has been promulgated raising the license fees and subjecting dealers to a tax proportioned to the number of inhabitants, with a proviso for considering the debts of the concern in fixing the fees.

Coming now to the Netherlands, I am glad to be able to recognize the wise enactments which your legislators have given you. They have thought, without doubt, and with strong reasons, in my opinion, that all fiscal measures would be ineffective so long as anybody or everybody should be at liberty to offer these mischievous drinks to the public. They have, therefore, prudently prohibited the combination of the trade in drink with a wholly different trade; and I appreciate this feature all the more because I see in France every trade, whatever be its nature, serving as a pretext for the sale of liquor, so that every person entering a shop, without thinking of harm, to buy food or any other goods, is exposed to the temptation of drinking alcohol, which he finds displayed before him. I am not, however, completely informed concerning the value of the results which this plan has brought forth. I have no data for comparing the statistics of the time before the measure was adopted and those following it, and the only statistics I have relate to the proportion of the victims of

alcohol per hundred of insane; from these it appears that after suffering a slight diminution on the application of the law, the proportion rose between 1878 and 1882.

From this summary I find that of the measures so far adopted against alcoholism those have produced the most important results which, taking account of human weakness and of the hardships of the struggle for existence in certain classes, have aimed to remove from the man the occasion for falling, in the adoption of which Norway leads among European states.

The repression which appears to me to be indispensable has so far played only a very secondary part; but I acknowledge that the German project presents a collection of repressive measures which may be of real efficiency.

If I could venture to formulate a few principles as the basis of legislation against alcoholism, I should propose: aiming at the dealers by limiting their number to a *pro rata* of the normal needs of the population; raising the license fee to the highest possible amount; giving license, as the German plan contemplates, only to persons of known morality; imposing on them, by a system of inspections and frequent analyses of their stock, the obligation to sell only completely rectified spirits; prohibiting their selling on credit, and declaring drink debts null; forbidding their selling to youths of less than twenty years of age; making them responsible for all mischief committed by persons coming from their establishments; and absolutely refusing license to all commercial establishments other than those especially devoted to the sale of liquors.

If we add to this an increase of the taxes on alcohol large enough to make the price of a glass too high for the man's purse, complemented with a reduction of the taxes on natural wines, tea, coffee, and sugar; supplementing this with frequent lectures on the benefits of sobriety and the anatomical injuries and physiological disorders produced by alcohol; and especially if we endeavor to preserve the rising generation from promiscuous associations and the corruption of the great centers, and instill into their hearts from infancy the principles of sound morals; and if the repressive laws against intoxication are rigorously executed the penalties against it are faithfully inflicted, and the protection of children against demoralization and abuse by unworthy parents which I have had introduced into our laws is guarded, we may perhaps see the rising wave of alcoholism recede.

This is the course, in my opinion, upon which those governments which, having assured the grandeur of their countries, perceive how it is threatened by alcoholism and how urgent is the necessity of arresting the progress of the vice, should now resolutely enter.

I do not know all the obstacles that may interfere in different countries against the efforts of the state to remove the danger. I know that in France and Germany the good intentions of the Government and Chambers will be strongly opposed by the innkeepers; but I know, too, that no obstacles are insurmountable to a political power strongly impenetrated with love of its country. —*Translated for The Popular Science Monthly from the Revue Scientifique.*

THE PAST AND FUTURE OF ALUMINUM.

By M. J. FLEURY.

AT the Universal Exposition of 1855 appeared for the first time an ingot of that silver-white metal from clay, as Sir Henry Roscoe called it. Aluminum does not seem to have attracted much attention from the public at that time. When it was exhibited again at London in 1862 and at Paris in 1867, in the shape of utensils of every sort, and jewelry, it had at first a success of curiosity, provoked by its extraordinary lightness of weight. But the difficulty of its manufacture and the consequent high price at which it was held, the delicacy of its color so easily soiled, caused it to be gradually abandoned in some of the arts, for which it was at first thought a new resource had been discovered. Its alloy with copper, aluminum bronze, notwithstanding its remarkable qualities of resistance and its beautiful golden color, hardly kept its place in industrial practice. Perhaps aluminum would have passed out of mention, except in laboratories, where its place is always marked, if its early history had not been associated with that of the progress of electricity, and if, by the aid of this new agent, its manufacture had not become so easy and so economical as to permit a considerable extension of its applications, and to provoke a revival of the hopes which had welcomed its beginning. These hopes are reasonable and are founded on the solid basis of the most serious scientific considerations. We have a right to expect much from this metal, an extensive use of it, and its substitution in many cases for others now at our service, provided it can be furnished at a price corresponding with that of other materials known in the arts.

Whether it presents itself in the earth of colors varying from yellow to brown, of which our fields are composed; or showing itself pure white, as in kaolin, clay is nothing else than a combination of alumina, silica, water, and other foreign bodies in varying proportions. Of this abundant earth, which forms approximately about half of the crust of the globe, the mass is about equally divided between silica the substance of rock crystal, and alumina;

and this, in turn with its earthy appearance, is oxide of aluminum. This metal, therefore, constitutes nearly a sixth part of the soil on which we spend our lives. The most abundant of all the metals, it is at the same time the one that is nearest to us. Thus alumina, and consequently aluminum, is literally under our feet—clay, of which it is the principal component, being found nearly everywhere. Rarely, and scattered in the masses of the rocks, precious gems may be found—emeralds, amethysts, sapphires, rubies, and topazes—which are only alumina, nearly pure in corundum, but alloyed with a little magnesia or lime in spinel.

It was not till modern chemistry was born that it became possible to separate aluminum from its earth. Carbon, which had been the chief agent for isolating the known metals from oxygen, was not effective in separating the elements of alumina; and even the electrical process with which Sir Humphry Davy produced sodium and potassium failed here. A roundabout process was devised. Oersted converted the intractable oxides of aluminum and magnesium, also not yet conquered, into chlorides, and Woehler decomposed them with potassium, taking advantage of the superior affinity of that metal for chlorine. Applying potassium to chloride of aluminum in the crucible, he obtained metallic aluminum and chloride of potassium. It appeared as a grayish dust, with a few globules, the largest of which was not bigger than a pinhead. From this small quantity only an incomplete determination of the properties of the element could be made. A more exact description was reserved for Henri Sainte-Claire Deville, who repeated Woehler's experiment in 1854. For the rare, expensive, difficult, and somewhat dangerous potassium he substituted sodium, which he found a simple method of extracting from sea salt; and instead of clay, the use of which required a preliminary separation of the silica and the alumina, he employed hydrated alumina, known as bauxite, of which considerable beds were worked in France for the manufacture of alum. Under the direct action of chlorine, a mixture of bauxite and sea salt became a double chloride of sodium and aluminum. The addition to this mixture, at the melting point, of the proper quantity of sodium, caused a separation of the aluminum, which collected in the bottom of the crucible. By remelting, the metal was cleared of most of its impurities and greater cohesion was given to its molecules, so that it could be cast into ingots. All this involved great expense, and the investigation could not have been effectively continued had not Napoleon III come to the chemist's aid with some of the unlimited funds of which he had the control. The next year, June 18, 1855, Jean Baptiste Dumas presented to the Academy of Sciences the first ingot of aluminum made in an industrial shop.

Under more extensive manufacture the metal has been studied at ease, and its physical and chemical properties have been exactly determined. It is silver-white, but little changed by the air, which gives it a slightly bluish tinge—except when it contains iron. Its most striking quality, and one which makes it most suitable for a large number of industrial applications, is its lightness of weight. Its density varies from 2·56, when it is in a molten condition, to 2·71, when its particles have been consolidated by hammering, and its mean density may be put at about 2·60—that is, it weighs about two and a half times as much as water, while steel is nearly three times as heavy, and copper three and a half times, silver four times, and gold nearly eight times; so that four times as many articles can be made from a given weight of aluminum as from the same weight of silver. In many cases one metal may be substituted for the other without inconvenience. While not so hard as gold or silver, aluminum is equally malleable and ductile: it can be beaten into thin pellicles that a breath will blow away, with which objects can be aluminum-coated as they are gilded. It can be drawn into wires finer than a hair, and yet so firm and supple that they can be woven with silk. It is less fusible than zinc and more so than silver, and is easy, therefore, to cast and mold. Although very sonorous, it has not yet been successfully cast into bells, because the repeated strokes of the hammer make it hard and brittle; but the tuning forks made from it are satisfactory to musical artists. The sulphurets, which blacken silver so quickly, are without action on aluminum. Similarly insensible to organic secretions, it lends itself to the making of certain surgical apparatus. Ingenious tubes have been made from it which permit patients who have been operated upon for tracheotomy to breathe, and American dentists have utilized it in the construction of their modern apparatus. It is equally fitted for making into plate and kitchen utensils, for which its specific lightness makes its use convenient. Its conductibility for both heat and electricity authorizes us to predict a fine future for it. It is, it is true, an inferior conductor to gold and silver, about as good as copper, and twice as good as iron; hence an aluminum wire will carry twice as great a quantity of electricity in a given time as an iron wire; or, to carry an equal quantity the aluminum wire need be only half as large; and aluminum being only one third as heavy as iron, it will have to be only one sixth as heavy. These properties should, were the cost equalized, make aluminum vastly more available for telegraphic and other electric wires than iron. Furthermore, aluminum not being acted upon by the air, galvanization, which is necessary for the preservation of iron wire, could be dispensed with.

Aluminum is, however, inferior to iron and steel in tenacity,

the quality of resisting the forces of pulling, bending, and twisting, which tend to break the metal or separate its molecules. Equal volumes of aluminum and cast iron have about the same power of resistance to these actions. That of copper is not quite double, but that of wrought iron is more than three times, and that of steel about five times as great. For purposes, therefore, where this quality is demanded, aluminum offers no advantages; but there are numerous other uses in which the question of a greater or less resistance is of no interest; and the other qualities of aluminum—its ductility, conductibility, and lightness—may be dominant reasons for employing it. Its use has hitherto been limited by the consideration of cost.

This difficulty is fast passing away as improved processes are applied, and the use of aluminum has been greatly extended and diversified since Sainte-Claire Deville exhibited the first manufactured specimen. In 1856 it cost one hundred and eighty dollars a kilogramme; the next year Deville was able to prepare it at La Glacière under more favorable conditions, and the price fell to sixty dollars. A year afterward the factory was removed to Salindres, where fuel and bauxite were within convenient reach. The price gradually fell; cryolite, a new aluminum mineral, discovered in Greenland, was introduced, and the metal cost only eighteen dollars a kilogramme in 1883. The manufacture was undertaken at several places in England, with improved processes based on the method of Sainte-Claire Deville. Mr. Castner devised a method of producing sodium by which the cost of that metal was largely reduced, and the price of aluminum suffered another fall. Then Mr. C. Netto devised a direct process for producing sodium by exposing pulverized caustic soda to the action of incandescent charcoal, and the cost of aluminum fell to seven dollars a kilogramme.

The brightest promises for the future of aluminum are offered through the electrical processes. When the flame of the voltaic arc is turned upon a mixture of pulverized mineral and charcoal a fusion takes place, and the metal, relieved by dissociation, flows out fluid, limpid, and brilliant. So fine a result, however, can be obtained only under the most favorable conditions, to secure which, not always with certainty, great pains are required. An easier process is to turn the voltaic arc, not upon the pulverized mixture, but upon a bath of mineral substances which have been previously brought to a condition of igneous fusion, as is done in the Cowles electrical process. Complex phenomena are then produced, both calorific and chemical. Important factories have been established for obtaining by this process both pure aluminum and its alloys with other metals, particularly with iron and copper. By it the company at Pittsburg obtained almost

chemically pure aluminum from the crude bauxites and corundums of which considerable quantities have been discovered in the northern United States. The factory at Neuhausen utilizes a part of the falls of the Rhine at Schaffhausen for the propulsion of powerful turbines which directly work the dynamos whence electricity is obtained for the production of aluminum and its alloys. Important manufacturing centers have also been established in England and Germany, and there are some in France.

By these new methods, which are still susceptible of improvement, a considerable saving over the old purely chemical processes is gained in the treatment of the minerals. In either case the chief effective agent is heat, and it is utilized far more completely in the electrical furnaces than in the older furnaces, which were subject to many cooling influences. Not more than four hundred grammes of coal burned in the furnace of a steam engine driving a dynamo will produce electrical energy sufficient to isolate in a molten electrolyte one kilogramme of aluminum. More than twenty times as much would have been required in the old chemical process. By virtue of this better utilization of heat, with greater profection in the equipment and management of the shops, the price of aluminum has continued to decline, till it is now very near the point when the metal can be profitably applied to the fabrication of many articles.

The alloys of aluminum now occupy a high position in practical industry. Aluminum bronzes and platings, lighter and more tenacious and more resisting than copper, and conducting heat and electricity better, will take its place. The new shops are also working for the production of cast and malleable iron, and they are in request by smiths for refining cast iron and steel.

The metallurgy of iron is now an exact science as well as an industry. Informed by analysis of the exact composition of the elements that enter into the fusion-bed, and of the character of the products at each moment of the operation, the metallurgist can determine with accuracy what he must eliminate and what add to give his product the quality required for the use to which it is to be put. A few hundredths of alloy will decide what it shall be. A little chromium will render artillery projectiles proof against breaking; nickel increases the resisting power of sheathings. Introduced at the right time into the Bessemer converter or the Martin furnace, a small proportion of the alloy of iron and aluminum communicates to the melted metal a fluidity which facilitates the disengagement of the gases that would otherwise remain imprisoned in the metallic bath, producing blow-holes, and destroying homogeneity and resistance in large pieces.

New uses are constantly found for the pure metal; less employed in jewelry, it is more used in the modest ranks of plated

ware and kitchen vessels. In Germany it has been introduced experimentally into the equipment of soldiers. Its alloy with the rare metal titanium, while still light, is very hard and tough. Could not picks, bayonets, sabers, and mess plates, imposing lighter loads on foot-soldiers, be made of it? The Russian army tried horseshoes of aluminum, and the horses of the Finnish dragoons, on which the experiment was made, are said to have gained perceptibly in speed by it. It has been introduced into machines, to reduce the dead weight—a gain of special value for aërial navigation and for cyclers. A canoe entirely of aluminum, hull and machinery, has been launched on the lake of Geneva, and suggests a new resource for the bold explorers of rivers with numerous rapids in Africa and elsewhere. Its application to aërostats is talked of.

The supposition is consistent with past experiences that new wants will arise as the means of satisfying them increase, and that the new metal, without infringing upon the domains of its predecessors, will in some way create the uses for which it will be employed. A salient fact in the history of the aluminum industry is the rigorously scientific character of the progressive steps in the discovery and production of the metal. Nothing has come about by chance, but all is the work of human intelligence. —*Translated for The Popular Science Monthly from the Revue des Deux Mondes.*

ELISÉE RECLUS AND HIS OPINIONS.

By Miss HELEN ZIMMERN,
EDITOR OF THE FLORENCE GAZETTE.

IT is strange how sometimes two men distinctly different seem to reside in the same person. Who would believe it at first sight that Elisée Reclus, the eminent geographer, the careful, accurate, and scientific writer, should also be an anarchist of the most pronounced and uncompromising type—the man who actually regards Ravochal, the perpetrator of the outrage last winter at the Café Very at Paris, as a great man who died for his principles without betraying his friends? This great, large-brained enthusiast and kindly human being has unfortunately got this bee in his bonnet, a moral twist, that hinders him from seeing that the wrongs of mankind can not be righted by laws or lawlessness, but are inherent in the very constitution of our globe and of our imperfect organization. In a perfect world, with perfect inhabitants, a perfect society, perfect conditions would follow as a necessary corollary. But when a great man goes astray it is always interesting to try and discern the why and wherefore. It is on this account that in this article we deal rather with Reclus

the theorician than Reclus the eminent geographer, whose fascinating books on geography have vivified a science too often presented in dull and lifeless shape before the world. As great a geographer as Humboldt, he surpasses him in the fact that, like all Frenchmen, and unlike most Germans (and Humboldt was no exception), he is a fine stylist. His eloquent, graceful periods make even dry dissertations pleasant reading. Had he not held such extreme opinions he might have attained even greater fame, if this be possible. In any case we might have had more scientific books from his pen had he not given so much time to writing and speaking on his hobby. As this hobby reveals the man, may we expose it in these pages, without, however, on that account committing ourselves to any idea that we share them or wish to commend them to our readers. But a psychological study is always worth making, especially when the subject is so eminent and world-known. Before laying before our readers Reclus's mature opinions, let us cast a glance over his past.

Elisée Reclus is the son of a French Protestant minister, one of twelve children, of whom several have distinguished themselves in various departments. With a father so overweighted with an enormous progeny it is obvious that Reclus early made acquaintance with the pinch of poverty, for to maintain such a family in luxury would drain even the resources of purses deeper than those of French Protestant pastors. Elisée was educated in Rhenish Prussia, and his university studies were made at Berlin. It was no doubt in that city that he became inoculated with revolutionary ideas, for his student life fell in the time of ferment that preceded the uprising of 1848. Owing to his extreme democratic opinions, he left France after the *coup d'état* of December 2, 1851, and for several years traveled through Europe and America. It was on his return from these that he first wrote for the Revue des Deux Mondes and other periodicals the account of his journeys and geographical researches, which at once placed him in the forefront of all living geographers. But side by side with these geographical studies he continued to take an interest in social politics. It was he who was the first to point out in France the rights and wrongs of the American war of secession. It was he who helped to enlighten French public opinion concerning the cause defended by Lincoln. In consequence, the minister of the United States in Paris proposed that, as an acknowledgment of the great services rendered by Reclus, a considerable sum of money should be presented to him. This money the young learned man indignantly refused, although at the time he was in great pecuniary straits. He stated that he wrote entirely that right and liberty might triumph, and not for pecuniary personal recompense. Soon after this he published his magnificent

work on physical geography, entitled La Terre; and about the same time, to mark his disapproval of the despotism of the empire, he enrolled himself in the ranks of the International. During the siege of Paris he assisted M. Nardar, the well-known aëronaut, in sending communications out of the city, and also fought bravely in the National Guard. When the insurrection of March 18, 1871, broke out, Reclus, after publishing an eloquent appeal to his countrymen in favor of conciliation, flung in his lot with the Commune, and was taken prisoner by the Versailles troops. He was sentenced to transportation for life, after having been retained prisoner for seven months at Brest, where he occupied himself with giving lessons in algebra and mathematics to his fellow-prisoners. Meantime, however, the scientific world of Europe was roused to indignation at the condemnation to perpetual exile of so eminent a man; and when peace was once more restored in France, a number of eminent men, among whom figured the names of Darwin, Wallace, Lord Amberley, and others, sent in a petition to the head of the French Government, begging him to consider that in sentencing so eminent a man to transportation for life he was depriving science of great and incalculable services. Their petition was listened to, and M. Thiers commuted the sentence of transportation into one of banishment. Reclus in consequence went to live in Italy, where he resumed his labors, and where after a short time he had the sorrow to lose his young wife, whom he ardently adored, and who had shared his exile. After this he resided for a time in Switzerland, on the shores of Lake Geneva, working alternately at his geographical and communistic studies. He refused to return to France before all the prisoners of the Commune should have been amnestied, an amnesty was not granted till 1879. Thus it will be seen that his scientific labors and his humanitarian endeavors have ever gone hand in hand, nor is it so very long since he returned to France. Scarcely had he come back than he gained for himself fresh notoriety as the frank initiator of the anti-marriage movement.

He lives in Paris in the greatest retirement, and is in his person a very modest and refined man who hates notoriety above all things, and dislikes even the idea of being spoken of in a newspaper or a review; and nevertheless he is perpetually acting and writing in a manner that must necessarily draw public attention to him. He is a friend in heart and idea of Prince Kropotkine, the celebrated Russian anarchist, and he too styles himself an anarchist in the true sense of the word as he would explain it —that is to say, not the man who blows up houses and murders innocent women and children, but one who wants to change society and objects to every form of government; who has no feeling for country or patriotism, but only for humanity. Prac-

tically Reclus never meddles with politics, he cares only for social questions—outside, of course, the range of his geographical work. He holds that the Revolution of 1789 destroyed the privileges of the nobles, but that humanity has not advanced at all, nevertheless, because the *bourgeoisie* has disadvantageously taken the place of the aristocracy and usurped their privileges; hence, that the people are rather more unfortunate than formerly, because they know now that they are so. He considers that the state of society in which there are only what he calls "*les satisfaits*" and "*les misérables*" is a most abominable state of things, and he and his friend ardently hope that their doctrines will prevail sooner or later and change the face of things entirely. From every point of view Reclus is a most sincere, good, and excellent man, who would not hurt a worm, but would not budge an inch from his opinions. He has two daughters, and, as he considers marriage a bondage, he has united them himself to the men they loved. They were married by him in his own fashion, without any religious or civil ceremony, in the presence of witnesses. They have children who bear the father's name, as they also bear it themselves, but it does not appear that any steps have been taken to legitimize these children according to the laws of the state. Rumor has it—but for the accuracy of this rumor we can not vouch—that Reclus has had to suffer for his departure from the recognized social forms, for it is said that recently one of these illegal husbands abandoned the wife thus given to him.

In order that his ideas may be spread among the masses, for whose instruction they are primarily intended, Reclus has written a little pamphlet, which is included in the publications of La Révolte, a weekly communist anarchical organ published in Paris. Among the contributors to this series we find Louise Michel and the German Most, whose pamphlet bears the uncompromising title The Plague of Religion. If Reclus, who is now no longer young, and who less and less likes to be disturbed in his life of retirement, is asked to explain his ideas on social subjects, he has of late invariably referred his interlocutors to this little booklet, saying that if any one would know exactly what he thinks about the present state of things, and what he hopes for in the future, they must read what he has written there, and also read the contribution to the same series of his friend Prince Kropotkine, for he entirely shares his views. Evolution and Revolution is the title of Reclus's pamphlet; Anarchic Morality, that of Prince Kropotkine. The price of these small pamphlets is ten centimes. They are bound in a glaring pink cover and printed on villainous and utterly abominable paper, making us feel that, if this be a specimen of the æsthetics of the future, we rejoice to think that that future will not be ours. The matter is in both cases, fortu-

nately, greatly superior to appearances. Though we may differ a whole sky's breadth from each of the writers, we can but acknowledge the ability displayed by both. Reclus writes in a style so pure, so limpid, so exquisite, that we find ourselves reading on and on for the mere pleasure of reading, almost without pausing to analyze the meaning of what we read. Prince Kropotkine's way of writing, on the contrary, is bold, almost rough, sharp, and incisive, extremely well calculated to impress his meaning on the memory of his readers. Both works are the very reverse of reassuring in their tendency. Reclus's fundamental idea is that "evolution and revolution are by no means contradictory terms; in fact, that the first includes the second as a greater includes the less." "Evolution," he says, "the symbol of gradual and continued development in custom and ideas, is ever represented as if it were the contrary of that terrible thing revolution, which implies change of a more or less brusque description. Men discuss the history of evolution, the history of the gradual development of feeling and intelligence in the depths of cerebral cells, with apparent and perhaps even sincere enthusiasm. But woe if some one mention to them the abominable theme of revolution, which issues out from the depths of thought into the street, accompanied by the roar of crowds and the crash of arms! But evolution implies revolution, because those classes of society which possess the advantages which revolution is calculated to destroy oppose themselves to the peaceful march of evolution, and thus are the cause of those same violent movements which they deplore." In melodious tropes Reclus describes these phenomena. Both evolution and revolution, he says, have two faces, one benignant and one harmful. Religions, which from his point of view are most undesirable plagues, invented to keep the human mind in bondage, are but springs ever welling up afresh from the relics of the past. Thus, Christianity uprose from the relics of paganism. The American and French Revolutions were the moments in history when at last the rights of man were proclaimed, but their utterance proved barren, for a new privileged class established itself on the ruins of the old. "It may be said that until now no revolution has been absolutely spontaneous, and therefore none has been completely successful. All the great movements that have occurred up to the present, without exception, have been more or less directed, and have in consequence only been successful for the man or class directing; hence each has had its morrow of reaction. Now, however, the effects of social science are recognized by all, and the study of social movements must lead to the logical and instructive progress of the human race." How a revolution undirected is to succeed does not appear. "We can only arrive at social peace," says Reclus, "by

a profound study of the laws of history. The chessboard is before us—we have but to win the game." In eloquent pages he then sets forth the objects of the great general revolution he longs for. Religion, war, and marriage are denounced in fervent terms; even universities and engineers come in for the general denunciation. Some one must suffer in such a general disturbance—let it be the rich, say some agitators; not so, says Reclus, there must be no suffering class. There will come a day when wisdom shall be stronger than power, but to this end all bonds must disappear, and patriotism among the rest. He points out in one passage how the present French revolution has but assumed the arms and the ways of the Government it succeeded, and is a despotism in all but in name. Anarchy, the human ideal, can never come from the republic, which is a form of government. Science itself has become the ally of power: witness anthropometry, which he holds is turning the whole of France into a prison. Hereupon follows a tirade in praise of the International, with allusions to the eight-hour movement and the 1st of May. "So the great days approach; evolution is finished, revolution will not lag far behind. Is it not accomplished from day to day before our eyes? The time will come when evolution and revolution will succeed each other, when we shall pass from desire to action, from the idea to the realization; it is thus that life works in a healthy organization, be it man or the world."

Thus far the thinker Reclus leads us, leaving us at last with this oracular prediction. The frank, outspoken sentences of Prince Kropotkine have a less melodious but more powerful and awakening ring: "Why should I be moral?" he asks. "Why is one line of conduct good and another bad? All the motives which were placed before us in the past have gone away." He is as iconoclastic as his companion—nay, more so. None of the old rules have any force for him, yet even for him there exists a right and a wrong—the right and wrong of the hive and of the anthill, in which he sees the only fundamental rule of right and wrong; in this not differing at all from Christian thinkers, who also hold that that which is good for the human race, which in effect produces or permits the human creature to obtain the largest amount of pleasure and to submit to the smallest amount of pain, is good, while its reverse is bad. Very paradoxical is this Russian prince. Thus, he maintains that in some forms of society even cannibalism is a virtue, especially the devouring of the aged and infirm. He is decidedly unjust to Christianity, which enjoins the doing to others as we would they should do unto us, crediting that system only with an order to abstain from doing to others that which we do not desire should be done to us. It seems as if he really anticipated with desire

and appreciation a state of social existence resembling that of the bees and the ants, though how this is to be reached through the entire and unchecked development of every human creature, no matter what his propensities or passions may happen to be, he does not explain. We will not be governed, he cries; but should this not also mean we have no wish to govern? Like Elisée Reclus, he aspires toward the so-called perfect state of society—the state of things, as painted by them, which the unillumined intellect can but look upon as most outrageously and abominably dull, not to say tyrannical. Where in their human anthill or hive would be the place for such distinguished and brilliant intelligence as their own? Not even by the help of Richter's delicious skit, The Social Democratic Future, can one realize what a society founded upon absolute equality would become. Equality, says Prince Kropotkine, is equity; but he forgets that his models, the bees, destroy one class of their number, and that the ants are as warlike as the Zulus. In the model society of Reclus and Kropotkine the person who has the largest number of moral habits is the superior, if one may use such a word when the fact is no longer supposed to exist. They hold that the immensely large proportion of humanity, if left uncontrolled, would act in a manner useful to their fellow-creatures. It is only the fatal effects of war and religion which have warped them from this tendency. This wonderful faith in the ultimate goodness of humanity is exceedingly touching. Both Reclus and Kropotkine would be willing to risk trying the experiment of removing all restraint from the actions of mankind, and it is this perverted, childlike faith that makes such good men dangerous to society as at present constituted. Leave men entirely free, they say; fear not their passions. In a society entirely free they offer no danger; yet in the same breath they say: "Defend your own liberty, do not let yourselves be enslaved. Oppose your social passion to the antisocial passion of your antagonist. The great causes of deprivation—capitalism, religion, law, government—must cease to exist. The source of morality is the conviction of one's own strength. Life can only exist on condition of spreading and growing. Be strong; overflow with passionate and intellectual energy, and you will shed over others your intellect, your love, your power of action. Behold to what all moral teaching is reduced when freed from the hypocrisies of Oriental asceticism!" "Fallen cherub to be weak is miserable," says Milton's Satan. "Every one," says Kropotkine, "has his ideal, and to act in disaccord with this ideal is to be wretched. Make the good of humanity your ideal, and morality follows as a matter of course." Such are the ideals of these studious dreamers—a dreamer's ideals, and realizable only in a dream.

CORRESPONDENCE.

IMMATERIAL SCIENCE.

Editor Popular Science Monthly:

THE criticism made by Mr. E. S. Moser, in his article in the November Monthly, is undoubtedly sound from the writer's point of view, which is that of physical science. And yet there are many persons—for one, the writer of this letter—who, while recognizing the untenableness from the scientific standpoint of the positions taken in Prof. Lusk's article, yet as to the main idea accept it as true. When Mr. Moser asks, What is the spirit? he well knows that no answer can be given in the terms of science. Nevertheless, the one who is put to silence by the question may have certitude of the reality of man's spiritual nature.

It seems to the writer that the plain issue which is raised in this ever-recurring discussion of the natural *versus* the spiritual is whether man possesses faculties higher than the rational faculties, by which he can have conviction of truth that can not be reached by deductive reasoning. That there is no inherent absurdity in this idea is evident on the principle of evolution. In the history of the animal kingdom there was a time when sentiency was the highest form of mentality manifested by animals. From animals of this grade were evolved others of a higher grade, possessing not only sentiency but also rationality. Why should there not be a further evolution, giving rise to another set of faculties, higher than the rational faculties? Through the exercise of these higher faculties man may have certitude of truth which the rational faculties alone are incapable of attaining.

May we not say that the faculties which are exercised in the acts of prayer and praise to a Supreme Being are such higher faculties? In the ideal human mind—one in which all the normal faculties have proportionate development—would there not be such higher faculties? Who has not experienced moments when it seemed natural to pray to God, and others when it seemed natural to praise him? And by the exercise of these higher faculties is there not attained a certitude of truths which belong to a higher realm than the truths about material Nature?

Let any one who thinks he must give a negative answer to these questions before making a final decision go back in thought to that stage in the evolution of his animal ancestors when first a rational nature was being added to the powers of sentiency. How long may not the animals of that stage have hesitated to be guided by the dawning light of reason? how long doubtful of the truths which the exercise of their newly received faculties revealed to them? JAMES H. STOLLER.

UNION COLLEGE, SCHENECTADY, N. Y.,
October 29, 1883.

TAMABILITY OF BIRDS.

Editor Popular Science Monthly:

SIR: The article in The Popular Science Monthly for November—Birds' Judgments of Men—was one that was full of interest for me by reason of the matter contained in the article itself, and also because it recalled some of my own experiences with our little feathered friends.

Situated, like the house of M. Cuniasset-Carnot, on the outskirts of the city, the one in which I spent the summer at the time in question was surrounded by trees of various kinds. Here the robin, bluebird, finch, oriole, and the sparrow, among others, came and built their nests season after season without fear or molestation.

Without doubt the kindness that was uniformly shown them and the care with which all avoided disturbing their nests prepared the way for the more familiar intercourse I succeeded in holding afterward with these cheery little tenants of our woods and fields.

One of the first methods I adopted for this purpose was to place a number of shelves in the trees, keeping them always supplied with foods, taking care as well that it should be done under their observation. This was easily performed, as they soon learned to note any movements on my part with this object in view.

My first advances were made toward the English sparrow, that Anglo-Saxon of our smaller birds. Always on the lookout to discover and recognize anything that may be of profit to himself, he is also the first to take advantage of it, to the exclusion of his less fearless companions. I taught them to know my whistle, to come at my call, and to eat the crumbs I dropped from my hand. Then I succeeded in having them take their food from the palm of my outstretched hand. At last, whatever doubt I might have felt as to their confidence in my good intentions was wholly dissipated by seeing them bring their young to me. These showed no signs of fear. On the contrary, they appeared to be as unconcerned about me as the parent birds that were feeding them at my feet.

They were always on the alert for their breakfast, flying from different quarters to my windows when I pushed back the blinds at rising. If for any cause they remained closed beyond the usual hour, the presence

of my little feathered pensioners was made quite evident by the hail-like pattering of their feet upon the tinned roof just below, where they hopped impatiently to and fro waiting for their matutinal repast.

The English sparrow, by reason of his domestic habits and acquired capability of adapting himself to the manifold and varying circumstances of our city and country life, has become one of the most knowing and observing of all our birds. But once a change in my clothing puzzled them. They knew my call, but the different color of my new garments seemed to have changed my personality. They would fly to me at my call, flutter about my head, hover over the food in my hand, and then, perching near by, would proceed to look me over and over with the most perplexed and serious air to fathom the mystery. After a while I established my identity and our old confidence was renewed. Indeed, it had become so complete that I now felt myself under a species of obligation never to disappoint them in their expectation of food, as they were on the watch for me whenever I appeared.

With the other birds my success was not so complete. But this was only what was to be expected. My attention had been mostly directed to the sparrow; the summer was drawing to a close, and they were seeking more congenial haunts. All, however, had become more familiar, for they seemed to have recognized my good will, and so much so that I feel assured that with the proper patience and favorable surroundings we can enter into very close and cordial relations with many of these little joyous minstrels whose beauty, song, and winged grace have brightened some hours in most of our lives.

Referring again to the English sparrow, it may be interesting to observe that I have seen him follow the robin about and snatch from his bill the worms as he pulled them out of the ground. Why the latter did not resent such audacious robbery I can not fancy, unless he knew that "discretion was the better part of valor"—that any attempt upon his part to chastise such a questionable messmate might bring down upon himself a mob of his companions.

His influence is already perceived in our streets, from which the once familiar pigeon is disappearing, as are many of our songsters from the field and garden, due also to his omnipresence. There is very little, if any, poetry or song in his life. His chief purpose seems to be "to possess the land," and to bring up as large a family as possible. Yet, while many have learned to regard him as a "wretched interloper," we can not but admire his hardihood, his intelligence, and his plastic instinct, by means of which he fits himself, like his human prototype, to the environments of the many regions he has invaded, and where, if the signs be true, he has come to stay and to exclude from their native haunts his more attractive and gracious rivals.

P. F. Schofield.

New York, *November* 18, 1893.

EDITOR'S TABLE.

PUBLIC OPINION.

THERE is nothing more tiresome than the platitudes in which popular orators and journals indulge when, generally for some sinister purpose, they set themselves to extol the wisdom and virtue of "the people." People who have any sense know just how wise and virtuous they are, and quite fail to see the point of the excessive adulation thus bestowed on them. It is difficult indeed to imagine what class of persons it is that can be gratified by praise of so inordinate and conventional a kind. Why should a lot of people who have chosen representatives of a certain kind care to be told that they are so very much wiser than the men they have chosen? yet that is the common refrain: the people are so much wiser and better than the politicians. If the people are so much wiser and better than the politicians, why don't they show their wisdom and goodness by bringing better men to the front? The men who are elected to-day may in a short time return to private life and become electors themselves: do they thereupon acquire a sudden increase in wisdom, and do they show their increased wisdom by helping at the first opportunity to elect worse men than themselves? That seems to be the way it is understood to work: the whole thing is fulsome and absurd to the last degree.

The truth, which, if it does not give

rise to this kind of talk, occasionally seems to afford a certain justification of it, is that, from time to time, "the people" defeat the expectations of the politicians by refusing to carry out the plans and arrangements which the latter have made; so that a "ticket" which, considering the party organization behind it, might have been supposed sure of victory, meets with ignominious defeat. It is much better to be wise sometimes than to be wise never; but it is not very satisfactory to reflect that an electorate which is capable of exercising wisdom and properly branding political immorality should require the stimulus or shock of some great scandal to bring its virtue to the front. The reason why politicians are encouraged to proceed every now and then to some unusual length in defiance of political principle is that, in general, they can reckon on the partisanship of their followers to support whatever they may propose. What the public have to do, therefore, when by a tardy or fitful exercise of political conscience they have escaped some disgrace, is not so much to congratulate themselves on a remarkable achievement as to wonder, with some little humiliation, why the achievement was necessary—why their political leaders ever came to propose to them anything so disgraceful. It is rare that a man is approached with a disgraceful proposition unless he has in some way created the impression that the proposition might be well received; and therefore, mixed with any lofty indignation with which he repels it, should be some heart-searching as to how the whole thing came about. Applying this to a case which is fresh in the recollection of all, how much of moral inertness, how much of blind partisanship, how much of indifference to higher considerations of national welfare must have been shown on many occasions by respectable voters, before the managers of a great party could venture to place on their ticket a name which the most elementary considerations of political or moral principle should have sufficed to exclude from it!

It is, of course, satisfactory to think that there are bounds which can not be passed—that there is a point at which the better sense of the community rebels—but it is impossible not to think at the same time that this better sense might be kept in more regular exercise. Instead of descending like a *deus ex machina* into the political arena on critical occasions to safeguard the state against some signal danger, why should it not be the daily providence and bulwark of the state? The modern state depends for its prosperity and security on the faithful performance by citizens of their political duties; and it therefore behoves every citizen to inform himself as to the issues of the day, to consider carefully which side he should take, looking to the greatest interest of the country, and to vote and otherwise shape his course accordingly. If this were done as a rule by all voters capable of forming an intelligent and honest judgment, there would be very little encouragement given to dishonest political machinations; and those elements in the country that count on political corruption in one form or another for liberty to pursue fraudulent and immoral ends would find their action so circumscribed that all the profits of their several nefarious trades would be gone. There is reason to hope, we are very glad to say, that the sounder elements in the community are becoming more conscious of their strength and more disposed to use it for the purification of politics. Not one recent election only, but many, have turned more or less on moral issues, and have turned in the right direction. Let there be no pause in the good work; above all, let there be no reaction. The effect upon the administration of the government in any country of a decided expression of public opinion in favor of what is right, rather than of what is expedient in a party sense, can not but be

beneficial. Does any one suppose that the public gets full value for the enormous expenditure incurred for the salaries of officials? If any one does, we venture to say that he is seriously in error. Neither the intelligence nor the zeal of public employees in general comes up to the standard that might be realized if our politics were dominated by higher principles; and not only is a vast burden thus laid on the industry of the country, but many advantages which might be secured to the public are lost. Let us make the most of any encouragement we have received; but let us not draw the lesson, either that the people at large are very wise and good, or that the forces of evil have been permanently discouraged. The people at large are good enough to do a great deal better than they generally do; that is about as much as can be said on that point. The forces of evil are hard to discourage and very hard to destroy. They watch their opportunity, and are as assiduous as the spider in repairing the party webs which an outraged public sentiment may have torn. Public opinion is something that should be invoked at all times against every form of evil, and every possible means should be used to keep it alive and active and watchful. The adulation so frequently bestowed upon "the people" is a moral narcotic rather than a stimulant, as it suggests that everything must go well in a country where there are such vast reservoirs of wisdom and virtue. The true note to strike is that of *responsibility*. An honest man does not require to be told he is honest; and a dishonest man is not made better by it. The message to each and all is, that we have public duties and responsibilities commensurate with the great advantages we derive from our membership in a civilized state, and that we can not neglect these without dishonor and loss.

INTERNATIONAL ARBITRATION.

It is greatly to the credit of the United States and Great Britain that they should now on several occasions have submitted disputes which might otherwise have given rise to war, to the decision of a court of arbitration, or, as in the case of the San Juan question, to that of an individual arbitrator. One conclusion that may be drawn from this course of procedure is that, as between these two countries at least, war is a discredited and obsolete method of settling disputes. The question now is why it should not soon become the same for all civilized nations. The burden of military taxation in Europe is becoming well-nigh intolerable. One or two countries, notably Italy, are now on the very verge of national bankruptcy, and all because the wit of man, at the close of the nineteenth century of what has been called the "Christian" era, can not devise any adequate means save war on a huge and most destructive scale for the adjustment of conflicting international claims. It seems impossible that the sin and shame of this should not before long become intolerable to all well-disposed men; and on the continent of Europe, not less than in England and the United States, the great majority of men may come under that designation. The time has arrived, we think, for a serious demonstration in favor of arbitration as a substitute for the barbarous method of the sword; and the duty of initiating such a movement would seem clearly to lie with the two nations who have themselves set the example of a successful and happy use of arbitration. The project of persuading the nations to turn their back on war is indeed a vast one, but that is no reason why it should not be taken in hand—why, in the first place, a rough sketch, as it were, of the conditions necessary for the realization of the object in view should not be made and taken into consideration. Of

course, if any one nation is cherishing schemes that are in their nature inconsistent with peace with its neighbors, that nation could not be counted on for any sincere co-operation; and therefore the first thing to do would be to invite from each nation as frank and full a statement as possible of its views and aspirations, in order that the extent to which these came into conflict with those of other nations might be determined. We can not resist the belief that, if the matter were taken in hand seriously, the British Government, as being more directly interested in the peace of Europe, taking the lead, and the Government of this country lending it all the moral support possible, a hopeful beginning might be made. The thing could not be done in a day; but, unless we have faith enough to believe in the possibility of its being done, how is it going to be done at all or at any time? War has lasted through nineteen centuries of the Christian era, and still exists as a horrible fact and still more dread possibility in the era of science. It has lasted too long. Christianity and science should unite their forces to crush it.

LITERARY NOTICES.

THE PSYCHIC FACTORS OF CIVILIZATION. By LESTER F. WARD. Boston: Ginn & Co. Pp. 369. Price, $2.

IN this book Dr. Ward elaborates and reenforces the main plea of his Dynamic Sociology, published ten years ago. His central thought is that civilization owes its chief impulse to man's conscious effort to better his lot—an effort in which, so far from imitating the operations of Nature, man has modified or even reversed them. In this view, civilization for its further advance must look more and more to a control in the highest sense artificial, which shall aim solely at the public good, restraining all self-regarding activities in conflict therewith. The chapters before us embody the observations of an accomplished naturalist, and add original and brilliant illustrations to an argument somewhat familiar. Every skillfully drawn picture such as this, which limns the felicity awaiting mankind when self-love and social shall be the same, kindles the moral imagination, and in so far has distinct value. But whether the practical orchestration of human wills and motives, which Dr. Ward holds to be eminently feasible, is feasible, or even possible, may well be questioned. As time goes on, and the problems of life, political and social, grow in complexity, the task of bringing self-interest and the public weal into accord does not become easier, as multiplied failures abundantly attest. One of the reasons is that the democratic spirit which justly maintains the equality of rights is apt unjustly to ignore or resent the inequalities of talent and character which difference man from man. And only a hearty acknowledgment of these inequalities can yield the assured leadership and the loyal adhesion upon which social progress largely depends. Dr. Ward holds that with better social conditions character would be reformed. True. But how can there be that in the mass which is not in the atom? Our author is of the school which would have reform begin at the outermost circle of human life, the political, and thence pass to the core and center, the individual heart. In this kind of project there is an oblique and subtle flattery in that blame for individual woes and privations is laid solely at the door of "society," of institutions, of somebody or something outside the sufferer himself. Never by any chance do the painters of social Utopias show how wide is the home acre for improvement, how much neglected it is, albeit that its plow awaits no sanction from the lawmaker, and how the despised field for tilth which surrounds every man's door is just the place for him to gain the skill, the discipline, needful in planning and carrying out the large transformations which gild the dreams of socialistic prophecy. Dr. Ward enlarges, and without exaggeration, on the wastes and burdens of industrial competition. Experience in Great Britain amply proves that many of these wastes and burdens disappear on the simple organization of the co-operative store—an establishment in this country as rare as an observatory. Co-operation requires forbearance, steadfast-

ness, strict probity; shall men be expected to manifest these first of all with regard to a few things or to many things? Our author has a passing word for "natural monopolies," and deems it desirable that they be nationalized. In the current discussion of these monopolies land always figures as the chief, and the one way of escape from the ever-increasing exactions of the landlord is declared to lie in his being superseded by the Government. Of a different stamp from the people who harbor this doctrine are the two million families in this country who have slipped from beneath the landlord's yoke, through the undramatic agency of the building association. Homely and humdrum enough is the virtue of thrift, but thrift and its fellow virtues of industry and sobriety mean trustworthiness. With its birth, and only with its birth, can the attack upon the obstacles to social reconstruction take heart of hope. In its hands self-help holds opportunities which, were they exhausted, would not simply contract the area for centralized sway, but incidentally prepare men to establish that sway in so far as it may be gainfully done.

Dr. Ward is too careful an observer to miss as a trait of the American public its distrust of governmental interference with individual activity. That distrust has not been unaffected by recent events. The Silver Purchase Act was an attempt to overrule the individual impulses of the people in a way which was to create for them new and gratuitous blessings as a community. At the date of its repeal the act had involved the nation in a loss of at least $400,000,000. This sum, vast as it is, forms after all but a solitary item in the cost of that more ambitious overruling of all for a few which masquerades as protection. In socialistic or, to adopt Dr. Ward's term, sociocratic legislation there ever lurks the danger that the interest of a band of manufacturers, mine-owners, soldiers, or office-holders can be made to appear identical with that of all. Experience proves that legislators are apt to form a class apart, separated from the public in a fool's paradise of echo and subserviency, and with interests often opposed to those of the people whom they ostensibly represent. At Albany and Washington a minority of them cemented together by the pursuit of plunder have repeatedly defied a majority whenever that majority has lacked close regimentation.

Dr. Ward adduces examples of species which with swift pace have stridden ahead on the artificial withdrawal of competition; he fails to refer to cases more numerous still where the absence of competition has ended in the degeneracy which overtakes the parasite. In the author's own city of Washington attention last year was drawn, on the floor of Congress, to the waste of public money in the counting and recounting, the polishing and labeling the pebbles of science by officials in the borrowed garb of the geologist; and last spring Secretary Morton, in taking charge of the Department of Agriculture, found one of his first duties to be in setting adrift the barnacles which in four short years had fastened themselves upon a single, and not particularly inviting, ship of state.

MODERN METEOROLOGY. By FRANK WALDO. Contemporary Science Series. New York: Charles Scribner's Sons. Pp. 460. Price, $1.25.

THE chief aim of this treatise is, in the words of the author, "to bring the reader into closer contact with the work which has been and is actually engaging the attention of working meteorologists rather than to present finished results." More than a third of the volume is devoted to descriptions of meteorological instruments and the methods of using them, with some account of certain meteorological laboratories. The details of equipment and routine of the observatory at Pawlowsk, Russia, are given with much fullness, and the author states that he knows of no similar account of the regular work of an observatory. A number of views of observatory buildings and their surroundings are presented, including several mountain observatories in the United States and Europe. The work of German meteorologists is given large space in this treatise. Thus the chapter on Thermodynamics of the Atmosphere is mainly a presentation of the ideas of Prof. von Bezold, as set forth in his several memoirs recently communicated to the Berlin Academy of Sciences. There is also a history of the various theories of general and secondary atmospheric circulation.

This is followed by an account of the principal results of meteorological observations up to the present time, and the work closes with a section on the application of meteorology to agriculture. Besides the views already mentioned the volume is illustrated with a large number of diagrams, charts, and cuts of instruments.

ZOÖLOGY OF THE INVERTEBRATA. By ARTHUR E. SHIPLEY. New York: Macmillan & Co. Pp. 458. Price, $6.25.

THIS is a text-book for college students who have some knowledge of biology, but is not intended as an advanced treatise. The author has undertaken to describe one example of each of the larger groups, with specified exceptions, and then to give a short account of the most interesting modifications presented by other members of the group. A great extension of our knowledge of the invertebrata has been made in the last few years, leading to a rearrangement of material and a revised classification. These facts have led the author to treat the subject largely from the morphological standpoint. More space has been devoted to animals intermediate between the larger groups than to the more specialized members of the groups. The text is illustrated with 263 cuts.

THE GENESIS OF ART FORM. By GEORGE LANSING RAYMOND. New York: G. P. Putnam's Sons. Pp. 311. Price, $2.25.

GOTHIC ARCHITECTURE. By EDOUARD CORROYER. Edited by WALTER ARMSTRONG. New York: Macmillan & Co. Pp. 388. Price, $2.

THE former of these two very suggestive and interesting works on subjects of art is described in the subtitle as "an essay in comparative æsthetics, showing the identity of the sources, methods, and effects of composition in music, poetry, painting, sculpture, and architecture." It is the result of an endeavor to trace to their sources in mind or matter the methods employed in the composition of the art forms; and as an incidental though seemingly necessary step to the accomplishment of this object the action of the mind in these methods has been identified with its action in scientific classification; and, having arranged them according to their logical order and development and added to them those methods hitherto recognized only indirectly or not at all, their character and effects are shown to be exemplified in all the arts, including music and poetry, etc., as well as in painting, sculpture, and architecture. It takes many centuries, the author says, "for such methods to develop into arts like those which have been named. But, after a while, these all appear. It is important to notice, too, that the way in which they differ from ordinary and merely natural modes of expression is the fact that they are not used, or, if so used at first, have ceased to be used for expression's sake alone. . . . While, therefore, the art-product is traceable to an expression of mental thoughts and feelings, the elements of which it is constructed are forms borrowed from Nature, and the method of construction, or composition as it is ordinarily called, is a process of elaboration." The theoretical has been so connected in the essay with the practical, as the author hopes, to adapt the work to the wants of readers who, while interested in one or other of these phases of the subject, are not interested in both; and the effort has been made to distinguish between well-grounded tastes and mere fashions or whims.

M. Corroyer's Gothic Architecture, translated from the French by Miss Florence Simmons under the editor's direction, is intended to give such an account of the birth and evolution of that form of the art as may be considered sufficient for a handbook. The author, writing from a thoroughly French point of view, is apt to believe that everything admirable in Gothic architecture had a Gallic origin. He dismisses vexed questions of priority with a phrase, and finds French influence in the examples which he cites traceable to suggestion from a French master or a French example. In this disposition he is very like nearly all other Frenchmen, in whatever field we take them—with a few shining exceptions like M. Taine, or, in the author's own field, M. Viollet-le-Duc, whom he sometimes contradicts. This characteristic weakness may, however, be discounted, and, when the allowance is made, does not greatly affect the value of the author's observations as a picture of Gothic development. Taking an evolutional view of the growth of Gothic architecture, he points out how material conditions and discov-

eries and their consequent social changes brought about one development after another in the forms and methods of the architect. Both of these books are liberally illustrated with engravings of the world's best works in the departments considered, or—when mistakes are presented as warnings—of some that are not so good.

PERSONAL RECOLLECTIONS OF WERNER VON SIEMENS. Translated by W. C. COUPLAND. New York: D. Appleton & Co. Pp. 406. Price, $5.

WE have already given the readers of the Monthly a foretaste of this delightful book in the sketch of Dr. Siemens, published in the October number, the data for which were derived from it. The book affords abundant instances of racy incident and adventure, keen character sketches, and historical reminiscences. The author came to the task of composing his recollections with a hesitation he need not have felt, for all the care they called for to give them the living interest they possess was the simple telling of them just as they presented themselves. But he was desirous of being his own chronicler, in order to preclude the possibility of future misunderstanding and misrepresentation of his endeavors and actions, "and I have an idea also," he adds, "that it will be instructive and stimulating to the coming generation to be shown precisely how a young man, without inherited resources and influential supporters—nay, even without proper preliminary culture—may, solely through his own industry, rise and do something useful in the world. . . . I shall, however, at the same time try to indicate those inner and outer forces which have borne me through weal and woe to the desired goals, and which have made the evening of my life an easy and sunny one." All this we find in the book duly presented, with the result, probably, of making the work a more interesting one than if the author had been bound by restraints and conventionalities. As we read, we are shown the surroundings and conditions of his childhood and youth, the salient traits of his various instructors, his joys and mishaps at school, his first experiments, and the adventures to which they led him; his military and political experiences, his introduction to commercial and public life, the gradual development of his inventions and enterprises, and the impression they made upon the arts and industries of the world. The last is, of course, the important feature of the work, around which the other and minor incidents entwine themselves as the vine around the tree trunk. The more we regard his inventions the more we are struck with the importance of the part they fill, and the extent to which they cover the industrial development of the world during the last half century. They include experiments with electricity when that force was still new as a worker; electroplating, in which Siemens was a pioneer; some of the earliest efforts at electric-telegraph signaling; the building of the first telegraph lines in Germany; the carrying of the telegraph through the countries of northern Europe and into Asia; in connection with these, trials of the relative advantages of underground and overhead wires and experiments in insulation, all of which were then new; journeys, full of adventure, full of amusing and exciting if not often thrilling incident, in connection with his enterprises; the laying and working of the first electrical submarine batteries; tentative experiments in cable laying under water; the laying of the first submarine cables, and the laying of cables thousands of miles in length under all the oceans—in all of which Siemens had a great part; the beginnings of electric railroading; and numerous other inventions of greater or less importance. Then the men with whom Siemens had to do during his busy life are introduced to us; persons in royal station, statesmen, ambassadors, financiers, philosophers, and men of science—the latter classes including, at least in Germany, some of the brightest lights of the half century. Besides the references to them as they come up in the course of the narrative, a separate chapter or appendix is given to the account of the author's scientific writings, in which the particular points he wished to bring out in them are more fully indicated. This enables us to mention one which, though only a theory that no one has yet ventured to accept—while no one has successfully contradicted it—must ever be associated with Siemens's deepest scientific studies: his theory of the maintenance of the sun's heat and light.

As may be readily perceived, the Recol-

lections cover a considerable variety of subjects, the presentation of which might have been made very dry and uninteresting. Siemens, in his artless way of telling of them, makes them all as interesting as the story of his first heroic act—his discomfiture of the gander that threatened and frightened his sister. The facts are among the most important landmarks of the scientific advance of the times; the presentation of them gains immeasurably in value by being made attractive.

THE GILDED MAN (EL DORADO), AND OTHER PICTURES OF THE SPANISH OCCUPANCY OF AMERICA. By A. F. BANDELIER. New York: D. Appleton & Co. Pp. 302. Price, $1.50.

MR. BANDELIER, one of the most painstaking and accurate of American archæologists, has in this volume presented the result of his researches in the history and dramatic incidents of the early gold-hunting expeditions of the Spaniards in Venezuela and Colombia and along the banks of the Amazon, and of the first invasions and early settlements of New Mexico. The book concerns two distinct scenes of adventure—the northern part of South America, and the Southwestern part of North America. On the stories of both Mr. Bandelier casts new and clear light. We do not know that the story of El Dorado has ever before been fully set forth and traced to its exact origin and foundation in fact in a book intended for popular use. It is so set forth in the first part of this book. With it is related the story of the expeditions of which this semi-mythical personage and his gold were the object; the foundation of the military and trading posts by hardly responsible adventurers on the coasts of Venezuela; the lease of Venezuela to the house of Welser & Co., of Augsburg; the condition and relations of the Indians of Bogotá, where El Dorado resided; the expedition of Dalfinger and the conquest of Bogotá by Ximenes de Quesada; his meeting on the plateau of Cundinamarca with his rival adventurers Benalcazar and Federmann, approaching the spot with the same object from different directions; the adventures of Georg von Speyer on the Meta, and of Philip von Hütten in search of Omagua; the tragic journey of Pedro de Ursua and Lope de Aguirre from Peru down the Amazon; and other expeditions of more or less significance, all marked by dangerous adventure and generally by disaster; and all prompted, in one way or another, by the vision of the Dorado, which the author likens to a mirage, "enticing, deceiving, and leading men to destruction." In the second part of the book, Mr. Bandelier does a like service for the myth of the seven cities of Cibola, which were the object of expeditions into New Mexico leading to the first settlements of that territory. To the determination of the location of Cibola he brings a considerable fund of linguistic knowledge and the fruits of industrious geographical and archæological exploration, and decides upon Zuñi as the chief of those cities. The story of the search for Cibola includes the relation of the marvelous adventure of Cabeza de Vaca, the missionary journey of Fray Marcos de Nizza, and the expedition of Coronado to Cibola, and thence, in search of Quivira, to the plains of central Kansas. Three additional chapters include an inquiry into the facts of the massacre of Cholula, inflicted by Cortes in 1519; the determination of the age of the city of Santa Fé, New Mexico; and the story of the later life of Jean l'Archévêque, the youthful accessory to the murder of La Salle, and of the fortunes of his family in New Mexico. These histories afford no end of exciting incidents and of themes on which romances and sensational stories might be founded; but Mr. Bandelier's object has not been romance or sensation, but the elucidation of the facts, the discovery of the real history. To this history his essays are a valuble contribution.

THE POINTS OF THE HORSE. A Familiar Treatise on Equine Conformation. By M. HORACE HAYES. New York: Macmillan & Co. Pp. 379, with Plates. Price, $10.50.

THE author of this book assumes that exact ideas on the subject of conformation are not current either in the traditions of people familiar with horses or in English literature. Both English authors and French have erred in trying to make general rules suitable to all kinds of horses, instead of pointing out that the standard of shape should to a great extent vary according to

the work demanded. Illustrations, moreover, of horses, or of special points of them, drawn without the aid of photography, are liable to be affected by the bias of the artist. In this book, photography, as far as practicable, is relied on for illustration. For further light on the respective points of speed and strength in the horse, the conformation of other animals that are distinguished by the possession of one or other of these gifts in a high state of perfection is examined. A more exhaustive inquiry is also made into the nature of the paces and of the leap of the horse than has previously been attempted; the object being to obtain from it exact deductions as to the best kind of conformation for various forms of work. The first principles of conformation having been laid down, descriptions are given of the structure of the body, the anatomy, the mechanism of breathing, the distribution of weight, the levers, the mechanism of locomotion and of draft, the attitudes and paces, the comparative shape, the trunk, the limbs, action, hardiness, and cleverness, condition and good looks, weight-carrying and staying power; blood, symmetry, and compensations, special points of various classes and various breeds of horses, wild horses, asses, the evolution of the horse, photographing horses, and proportions of the horse; concluding with criticisms of painters' horses. The book is furnished with a bibliography and an index, and is illustrated with seventy-seven plates, reproductions of photographs, and two hundred and five drawings.

In reading over the Rev. A. J. Church's book of *Stories from the Greek Comedians*, we are reminded again of the intense human-likeness that pervades all the Greek writings, which has given them their long life and makes them as fresh and readable as the day they were written. We should hardly anticipate finding in the little pieces of Aristophanes, written in the days of the Peleoponnesian war to make the Athenian populace laugh over the petty vices and follies of their fellow-citizens—and reflect, if they would, over their own course—character sketches that would fit as well to-day in New York or any other American city: exposures of tricks and devices to gain influence, wealth, and power, from which those now familiar among our own politicians and speculators might have been copied; views of similar "rings" and similar demagogues currying favor with the people in the same ways, and a similar populace binding itself in consideration of little bits of patronage and flattery to them; the "labor element" with its demands and threats and the leaders bowing to them. But these are all to be found in one or another of the nine comedies of Aristophanes; and he might as well have lived and written in New York or Chicago at the end of the nineteenth century as in Athens 2,300 years ago. His manner of presentation might be changed to suit modern fashions, but the substance and the essential features of the characters and situations would be the same. Besides Aristophanes, Philemon, Diphilus, Menander, and Apollodorus are represented in the book, having passed through the Latin versions of Plautus and Terence. Mr. Church does not give us the plays as such, but the kernel of them, in the form of stories, with parts of the dialogue. (Price, $1.)

The bulletin on *The Salt and Gypsum Industries of New York*, contributed to the New York State Museum by *F. J. H. Merrill*, Assistant State Geologist, is published in accordance with the law of 1892 relating to the appropriation for the geological map. Its purpose being not merely to publish such new information as can be gathered, but to give in concise form what has previously been made public, besides the author's own surveys, other authentic sources of information have been drawn upon. The account proper of the New York salt beds is preceded by general observations on the distribution and origin of salt, the composition of sea water, and the deposition of salt beds. Then are given the story of the development of the Onondaga salt field, the discovery of rock salt, the geology of the salt and gypsum, the altitude of the salt beds, well boring and tubing, the mining of rock salt, analyses; descriptions of the manufacture of salt in the State of New York by solar evaporation, direct fire evaporation, steam evaporation, and vacuum evaporation; with comparison of brines and processes, and statistics and facts. The account of the gypsum industry in New York, following the articles on salt, includes the descriptions of

gypsum quarries, statistics of the annual production of gypsum, and an account of the uses of gypsum.

In *The Cosmic Ether and its Problems* that mysterious substance or agent is presented by Mr. *B. B. Lewis* as the invisible actuator of the world of matter and life. Accepting the current theories of the ether the author elaborates them and applies them to the accounting for various cosmic and terrestrial phenomena more positively, perhaps, in some instances, than sober science is yet ready to assert, though we have not noticed that he transcends the bounds of some scientific speculations. The field of knowledge outlined in the essay seems to find a definite limit, the author says, only on the one hand in the direction of inquiry as to the nature and origin of the material molecule, and, on the other hand, "as to the separate entity and perpetuity of that ether inspiration constituting the sentient, intelligent personality actuating the physical life organism"—which will doubtless remain "permanently unanswerable to scientific methods of investigation." (Published by the author at Bridgeport, Conn.)

The same subject is treated in a very different manner by *Terence Duffy*, author and publisher, of San Francisco, in a book entitled *From Darkness to Light*, which is further defined as Duffy's Compendiums of Nature's Laws, Forces, and Mind combined in one; conformable to this, his great discovery that the sun and earth are the poles of the magnet. "Explains the motion of the earth, how maintained, what space is, what force is," etc. The author has intended, he says, to write as he understands, and to be as concise as possible, in plain words without any elaboration. We can not tell whether he keeps within science or flies away beyond it. His statements, as they read, have an air of absurdity; yet when we take a passage, analyze it, and translate it into usual language, it appears that the author may mean well, after all. The book's only value is as a curiosity.

A study of *The Deadly and Minor Poisons of Toadstools* is published by Charles McIlvaine, of Haddonfield, N. J. By toadstools the author means visible fungi as distinguished from microscopic. To the alkaloid, or poisonous principle, he gives the name of amanitine, preferring it, as derived from the name of a family of plants, to muscarine, the usual name, which relates to a species. Its most certain and powerful antidote he finds to be atropine.

The *Eleventh Annual Report of the United States Geological Survey* contains the usual account by the director of the operations of the year, in which the value and efficiency of the several divisions are carefully pointed out, followed by administrative reports of the heads of divisions. Two papers are appended to the report of operations: the first is on The Pleistocene History of Northeastern Iowa, by W J M'Gee; and the second on the Natural Gas Field of Indiana, by Arthur John Phinney. Mr. M'Gee's paper is illustrated with forty plates and one hundred and twenty cuts and Mr. Phinney's with five plates. A second volume contains the second annual report of the director upon the Irrigation Survey. This embraces the results of the work of the divisions of hydrography, topography, and engineering for the year ending June 30, 1890, together with a detailed statement made by the director before a committee of the House of Representatives, discussing the problems of irrigation in the arid lands of the United States. It appears from the report that a great deal of work has been done in locating agricultural lands that are accessible to water, in gauging rivers and rainfall, and in surveying reservoir sites. The text is accompanied by sixty maps and views and four cuts of apparatus.

In *A Select Bibliography of Chemistry*, an attempt is made by *H. Carrington Bolton* to collect the titles of the principal books on chemistry published in Europe and America from the rise of the literature (1492) to the close of the year 1892. The term chemistry is taken in its fullest significance, and the bibliography contains books in every department of chemical literature, pure and applied. It is confined, however, to independent works and their translations, and does not include academic dissertations nor "reprints" and "separates," and no attempt has been made to index the voluminous chemical literature, except in the section of Biography. Full bibliographical details have been given where possible. A considerable number of the books have been personally examined,

and are distinguished by a mark signifying the fact; "and for these alone can the compiler be wholly responsible." To facilitate reference the work is divided into the several sections of Bibliography, Dictionaries, History, Biography, Chemistry, pure and applied, Alchemy, and Periodicals—the last section having been taken from Prof. Bolton's Catalogue of Technical and Scientific Periodicals. Notes and comments, bibliographical and explanatory, have been occasionally introduced to aid students in conceiving the character of a book or the status of its author. The Bibliography forms volume xxxvi of the Smithsonian Miscellaneous Collections.

Mr. *B. Douglas Howard*, in a book entitled *Life with Trans-Siberian Savages*, describes his visit to the Ainus of Sakhalin, whom he characterizes as "the most ancient, distant, and least known savages surviving in Asia." There has been very little communication between this island and the rest of the world, and there will hereafter be less, as the Russians have made it a penal colony and secluded it. Mr. Howard's relations of his observations sound more like those of a globe trotter than of a profound student, and his accounts differ in several respects from those given by other writers of the Ainus of Yezo. He represents them as plunged in the lowest savagery. He also visited the Ainus in Yezo, and found them little better. Yet he thinks that through the Ainus of Yezo, with whom an intercourse exists, we may learn to understand their more primitive brethren in Sakhalin. He further attempts to elucidate the Ainu religion. (Longmans, Green & Co., New York. Price, $1.75.)

Mr. *W. J. Johnston* has aimed, in the preparation of his *Elementary Treatise on Analytical Geometry*, at an easy and gradual development of the subject. The requirements of two classes of students have been kept in view: First, students in the university colleges, by whom a limited course of the subject is read, and for whom such a course is marked out; and, secondly, candidates for mathematical honors, for whom the chapters on Trilinears, Reciprocal Polars, and Projection are included. These chapters will also serve as an introduction to the writings of Dr. Salmon. Many other features are introduced, the usefulness of which will be perceived by the student. (Macmillan & Co.)

A work on *Heat*, prepared by *Mark R. Wright*, is intended for those who have had some elementary reading on the subject, or who are able at once to attack a more advanced work, and is intended to place before such the leading facts and principles. Among its features are the incorporation of numerical examples to be worked out by the student, and descriptions of experiments to be repeated. While the author rejoices at the disappearance of the method of studying a science from a text-book alone, he suggests that too much as well as too little time may be spent over experimental science; "mental inertia is as possible in the laboratory as in the lecture room." An elementary chapter in thermo-dynamics is given, with an attempt to explain and illustrate by examples the first two laws and the meaning of Joule's and Thomson's experiments. (Longmans, Green & Co., New York. Price, $1.50.)

In connection with the system of meteorological observations established by the Smithsonian Institution, a collection of meteorological tables was compiled by Dr. Arnold Guyot, and published in 1852 as a volume of the Miscellaneous Collections. Second and third editions were published in 1857 and 1859, and a fourth in 1884—all the successive issues being revised and added to. The editions having been exhausted, the work has been recast; and the tables are divided into three parts — Meteorological Tables, Geographical Tables, and Physical Tables—each representative of the latest knowledge in its field, and independent of the others; but the three forming a homogeneous series. The first of these parts—*Smithsonian Meteorological Tables*—now published, is, therefore, essentially a new publication. It is conformed, as far as practicable, with the International Meteorological Tables. A large number of tables have been newly computed.

Cortlandt F. Bishop contributes to the Columbia College Series in History, Economics, and Public Law a study in the *History of Elections in the United States*. General and local elections are considered separately. The history is given for each of the several colonies. The qualifications required of electors

are classified as ethnic, political, moral, religious, those of age, sexual, residential, those of property, and miscellaneous; and the conditions regulating the admission of freemen are described. The account of the management of elections includes many particulars of routine, with provisions against fraud, proceedings in contested elections, the privileges of voters, compulsory voting, bribery and other means of influencing voters, and the sanction of the election laws. Local elections are classed as town elections, parish elections, and municipal elections. Additional documental and tabular information is given in the appendices.

Mr. *Arthur J. Maginnis's* volume on *The Atlantic Ferry; its Ships, Men, and Working*, was the first work in which the transatlantic steam trade was fully described in all its parts and all its relations. It was, however, a large volume and expensive. A popular edition of the work is now published in which, by the omission of a few chapters not of great interest to the general public, and of illustrations whose value is mainly technical, the public demand and the average purse are more directly catered to. It embodies a careful and complete record of the doings of the great transatlantic steamship companies from early days to the present time. (Macmillan & Co., New York.)

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POPULAR MISCELLANY.

Political Science at the Brooklyn Institute.—The School of Political Science of the Brooklyn Institute announces an advance course in American politics, conducted by Dr. Lewis G. Janes. It will be the aim of the instructor to give a concise and correct history of our national politics from the Revolutionary period to the present time, with some account of the great statesmen and political leaders of our country. A clear statement of the facts of each political situation, with a just view of the great legal and constitutional questions involved in our political controversies, without partisan bias, will enable the student to form an intelligent judgment upon the several topics. The lectures of the first term will be devoted to the formative period of our politics, from the Revolution to the Mexican War; those of the second term to the period of reconstruction, from the Mexican War to the present Five discussions are also provided for, concerning the relative influence of the ideas of Jefferson and of Hamilton in molding American institutions; the good or evil of the influence of Andrew Jackson in our politics; the justice of the Mexican War; the impeachment of President Johnson; and the wisdom of President Cleveland's pension vetoes. The courses will be given to two classes, in two sections of Brooklyn, on different evenings of the week.

The Grave of R. A. Proctor.—Prof. Richard A. Proctor, the eminent astronomical writer, died in this city on his way from his home in Florida to fulfill lecture engagements in England, September 12, 1888, of yellow fever. The attack was sudden, and death followed very quickly. None of his family were near him, and he was buried by strangers in the lot in Greenwood Cemetery owned by the undertaker who took charge of his remains. No further care seems to have been taken of his grave until attention was called to its neglected condition through dispatches published in the papers by Mr. Edward J. Bok. A lot was then provided and a suitable monument was ordered by Mr. G. W. Childs, of Philadelphia, and on October 3, 1893, the remains were removed to this lot in the presence of a number of citizens, thus expressing their regard for Prof. Proctor's memory and for his services to science, with religious exercises and a eulogy by the Rev. Dr. T. De Witt Talmage. The lot in which the remains have been permanently interred is near the Fort Hamilton Avenue entrance to Greenwood Cemetery, opposite the village of Flatbush, and is surrounded by a substantial railing. The monument is of polished bluish Quincy granite, and besides the formal record bears the following tribute by Herbert Spencer: "On public as on private grounds Prof. Proctor's premature death was much to be lamented. He united great detailed knowledge with broad general views in an unusual degree, and, while admirably fitted for a popular expositor, was at the same time well equipped for original investigation, which, had he lived, would have added to our astronomical knowledge. Prof. Proctor was also to be admired for his endeavors to keep the pursuit of science free from the corrupting and paralyzing influence of state aid. HERBERT SPENCER."

Inductoscripts. — At the Nottingham meeting of the British Association for the Advancement of Science an interesting feature was introduced in the display of novel scientific apparatus and exhibits. Among these were the "inductoscripts" of Rev. F. J. Smith, obtained by placing an ordinary photographic plate, film upward, on a metal plate. A coin, or other metallic conductor with a design upon it, is then laid on the film and a discharge of electricity is passed from the coin to the metal plate. On developing the photographic plate in the ordinary way the design of the coin appears upon it. An instrument designed by Prof. Milne, F. R. S., of Japan, for registering the intensity of earth tremors, was also exhib-

ited. A pyrometer of platinum, in which was measured the electrical resistance of the metal when exposed to high temperatures, was shown by Mr. Callendar. The display of electrical apparatus also included a very fine high-resistance galvanometer designed by Prof. Oliver Lodge for physiological work; and a magnetic curve-tracer contributed by Prof. Ewing. An instrument invented by Mr. John Anderton for projecting solids on a screen attracted much attention. Prof. Boys exhibited photographs of flying bullets, and Dr. Isaac Roberts some admirable photographs, chiefly of nebulæ, showing the probable formation of heavenly bodies. The marked success of the exhibition may lead to like collections being displayed at future meetings of the American Association.

Diversity of Forms and Conditions of Animal Life.—In a paper presented to the Convention of the College Association of the Middle States and Maryland, Dr. Spencer Trotter, speaking of the diversity of life on the earth's surface, remarks upon its correspondence, in a broad way, with the diversity of surroundings. Aquatic animals, like fishes, crayfish, and many insects, inhabit the waters of ponds, lakes, and streams. Frogs and other amphibious creatures are denizens of bays and streams. Some snakes and turtles are aquatic, while others are wholly lovers of the dry land. Birds are found in every situation: ducks and divers on the lakes and rivers; herons and bitterns in marshy fens; gulls and petrels on the open sea; sandpipers along the shores; eagles on lofty mountain peaks; while a host of species enliven the woods and fields. The haunts of mammals are no less diversified. The tree-loving squirrels, the burrowing ground hog, the mole digging out its long subterranean galleries, the water-loving beaver and otter, are each and all associated in the mind with their favorite surroundings. The idea of the animal and its particular home is not new. The story is told in peculiar language in Psalm civ: "The cedars of Lebanon, which he hath planted; where the birds make their nests: as for the stork, the fir trees are her house. The high hills are a refuge for the wild goats; and the rocks for the conies." If this diversity of life is so apparent in a limited area, it is far more so when we come to journey over an extended portion of the earth's surface. As the horizon widens newer and more significant features rise into view. Lofty mountain ranges, broad seas, trackless deserts, treeless plains, and vast forests successively present themselves. Climate and vegetation change from one region to another, and it is not a matter of surprise to find corresponding changes in animal life. Many kinds of animals are limited to particular regions, while others range through wide areas of country under a variety of physical changes. A traveler starting on the Atlantic seaboard of the United States and journeying westward along the fortieth parallel will pass successively through a number of distinct regions, each characterized by certain conditions of climate, vegetation, and peculiar animals. A number of familiar forms will, however, be found throughout the entire extent of the journey across the continent. If the traveler cross the Pacific to Japan, he will find forms of familiar types, though the species are all different from those he knew in America. Should he sail westward by the shortest route to England, he would pass the shores of countries wholly different from those he had left and from each other, each tenanted by strange forms of life—beasts, birds, reptiles, insects, and vegetation—distinct from any he had previously seen. In England, he would be struck by the likeness of the birds to those of Japan, while he would see none of the familiar species of North American birds. We learn from a survey of these conditions how intimately related an animal is to the earth, and how each species is fitted to the special conditions of the region it inhabits.

Crocodiles, Alligators, and the Heloderm.—Crocodiles from the Nile, India, and Ceylon share the tanks at the London Zoölogical Gardens with the alligators from America. The crocodile, says an English writer who has observed them, evidently bears the same analogy to the alligator as the frog to the toad. It is lighter in color and in build, and a more active as well as a more malicious creature. It is not so entirely hideous, though the lower jaw shows projecting tusks like those of a wild boar. The creature's eyes, celebrated in connection with the "crocodile tears"

with which legend declared that it attracted its sympathizing victims to the bank of the stream, are highly decorative, if not beautiful. The head, narrow and flat, resembles the head of a snake; the nose is sharp, and the fixed and motionless eyes are of the palest dusty gold, set in a short, horny pillar of a deeper golden brown. The crocodile's coat of armor is less complete than that of the alligator, and its quick, vivacious movements make it far more troublesome to the keepers when the tank has to be refilled and cleaned than the big alligators, which will allow themselves to be used as stepping-stones as the water ebbs away. "The heloderm, a fat and torpid lizard from Arizona, is supposed to be the sole existing member of its tribe, which possesses not only the poison glands that exist in most of the toads, but also the true poison teeth, with a channel for the emission of the venom. The lizard is about a foot and a half long, with a fat, fleshy body, a round tail ending in a blunt point, and a flat head with squared sides, resembling a small padlock. The whole body is covered with a curious coat of scales, like black and pink beads, arranged in an arabesque pattern. In its daily life it is a dull and stupid creature, feeding mainly on eggs, which it breaks and laps with its tongue. Its first and only victim was a guinea-pig that was put into its cage with a view to testing the reports as to its poisonous nature, which were by no means universally credited. The lizard bit the guinea-pig in the leg, and the animal died in a minute and a half, almost as soon as after the bite of a cobra."

Fresh Air for Legislators.—The Speaker of the British House of Commons recently pointed out a great need of the house over which he presides, and of other legislative bodies as well. Having arrived at Leamington for a little rest, he expressed his pleasure at finding himself there, "under the open air of heaven," after scenes of great anxiety and responsibility. There are very few men, as the Lancet remarks, commenting on this observation, having business of their own to attend to who can stand the work of Parliament from three in the afternoon till twelve at night without breaking down. The air of the house—whatever the "scientific ventilation"—is not the "open air of heaven." In addition to the want of air and want of space, are the temperature of discussion and the tension of highly strung men greatly differing in opinion. The Speaker is quoted as saying that the deterioration of members in health is evident from day to day, and that he sees men gradually becoming degenerate. He has been told by a cabinet minister, who is a peer, that he can recognize members of the House of Commons "by their pallid countenances," and can distinguish between them and members of the House of Lords. "It is the height of unreason to expect good legislation under such absurd conditions."

Requisites of a Flying Machine.—The principle seems to be accepted now by most of the students of aërial navigation that the successful air vessel, instead of a balloon, must be a body heavier than the air, and must be sustained as well as propelled in some way similar to that by which a bird flies. This principle was fully set forth in The Popular Science Monthly for January, 1892, by M. G. Trouvé, whose aviator, therein described, had wings acting almost precisely like those of a bird. M. Trouvé proposed for his machine an ingenious motor, which was to be actuated by the alternate compression and expansion of a gas in a Bourdon tube. Previous to M. Trouvé's paper, articles setting forth the principle of "heavier than the air" had been published by Mr. O. Chanute, Prof. S. P. Langley, and Mr. H. S. Maxim, and several have been published since in American magazines and journals. A writer who discusses the subject of aërial navigation in the Boston Herald raises the objection to a wing-motion, such as M. Trouvé's aviator contemplates, that the power needed to secure the velocity which an oscillating machine would require would probably cause the machine to destroy itself by the violence of its own vibrations. He proposes instead to depend on an aëroplane to hold the machine in the air, and to use a screw propeller as a source of motive power. He would pattern and proportion the aëroplane after the position of the motionless wings of a loon in scaling descent, as after they have been paralyzed by a shot hitting the brain; place the screw in front, on the principle that an arrow can not fly except with its heavier end foremost, and

guide the machine by horizontal and vertical rudders. The machine may be started by causing it to descend an inclined plane, and then to move horizontally, when its course is that of a scaling bird, and the power is applied, with the rudders, to keep up and direct the motion. Few persons who have seriously considered the subject now doubt the possibility of aërial navigation on the principle of "heavier than the air." But the construction of a practicable machine demands a variety of gifts and resources not to be found in one man: there must be an inventor, a mechanical engineer, a mathematician, a practical mechanic, and a syndicate of capitalists.

The Earliest Historical Art.—The earliest condition of art in Egypt, says Prof. W. M. Flinders Petrie, stands in a far different light from that of the history of art in other countries. In the first place, it is as early as, or earlier than, any other source of art that we know. Other countries have largely borrowed from Egypt or from Mesopotamia, but these two great deltas have not had any external influence acting on them; they stood far in advance of the civilization of the rest of the world in the early ages, and their art appears to be the outcome of the first stable and well-organized governments that were known. Tranquillity and the command of large resources were needful before any great progress could be made in architecture or the imitative arts; and no land appears to have enjoyed such conditions before the dawn of the historical period in Egypt. We have, then, to deal with a state of things in which art was, in the course of actual growth, free from the influence of any external guidance, and with only its own antecedents to build upon. This art also stands apart in the fact that all traces of its origin and rise are absent. We are still as much ignorant as ever of the course of its development. Where the tentative stages are to be found which led up to the triumphs of the fourth dynasty is as yet a mystery. Certain sculptures, which are undoubtedly very early, have been assigned to the second and third dynasties solely on account of the style. But there is no absolute evidence of the date of a single sculpture or a single block before the first king of the fourth dynasty, Snefru (the predecessor of Khufu, or Cheops), under whom we find some of the most perfect works that ever were executed. In one line, however, there are remains of an earlier style. The rock carvings of Upper Egypt certainly date back to a long prehistoric age—an age when the ostrich and the elephant were familiar in Egypt. But these rude figures have no relation to the art of historical times; and we should as soon learn the history of the Parthenon from the weapons of the stone age in Greece as trace the Egyptian schools in the rude carvings of the primitive man.

Public Parks in Massachusetts.—The Trustees of Public Reservations of Massachusetts is a chartered body established for the purpose of providing a ready instrument by means of which any person or body of persons may insure the preservation of any beautiful or historical place in the State. This may be accomplished by putting the tract in its hands. It also receives money for the maintenance and adornment of such places. As the years pass, a variety of motives are found to inspire the giving of lands into the hands of the trustees. The largest recent instance of this confidence is the gift of twenty acres of fine woodland in Stoneham by Mrs. Fanny Foster Tudor, now deceased, named by her desire, in memory of her daughter, Virginia Wood, for which a maintenance fund—the Virginia Wood Fund—has been collected and invested by other friends. It appears, from facts collected by Mr. J. B. Harrison respecting the present provision of open spaces in Massachusetts, that the large areas of undivided common lands which were once to be found in most of the townships of the Commonwealth have all been allotted or sold to individuals, except in Nantucket, where there still remain at least one thousand acres open to the public. The Park Board and Water Board of Lynn have lately restored to public ownership about two thousand acres of woodland which was once a common of this large kind. The smaller commons which the first proprietors of townships almost invariably laid out for "training fields" and sites for "meeting houses" appear to be still the only public open places in most of the townships of the State. Some of them have been en-

croached upon, some have passed into the exclusive possession of the "first churches," some into the exclusive possession of the townships, and some are said to be still owned jointly by township and church. Where the towns have come into possession they have frequently given the charge of the commons to village or township improvement associations. Only a few of the rural townships have acquired new public open spaces in recent years. In Manchester public rights in certain sea beaches have been established and a long strip of roadside woodland has been deeded to the town in trust. In Sheffield a beautiful pine grove is held in trust for the public by five trustees. Georgetown has laid out nine small spaces within forty years. In the cities of the State the General Park Act, passed in 1882, has borne excellent fruit.

Sanitary and Climatic Influence of Forests.—Concerning the sanitary and climatic relations of forests, Mr. B. E. Fernow concludes, after a discussion of the subject, that the influence claimed for them in promoting greater purity of the air through the greater production of oxygen and ozone does not seem to be sufficient; that the protection they afford against sun and wind and consequent absence of extreme conditions may be considered a favorable factor; and that the soil conditions of the forest, which are unfavorable to the production and existence of pathogenic microbes, especially those of the cholera and yellow fever, and the comparative absence of wind and dust, in which such microbes are carried into the air, may be considered as constituting the principal claim for the hygienic significance of the forest. We may summarize, he says, by saying that the position of the forest as a climatic factor is still uncertain, at least as to its practical and quantitative importance, but that its relation to water and soil conditions is well established. As a climatic factor the forest of the plain appears to be of more importance than that of the mountains, where the more potent influence of elevation obscures and reduces to insignificance the influence of their cover. As a regulator of water conditions the forest of the mountains is the important factor; and since this influence makes itself felt far distant from the location of the forest, the claim for the attention of government and for statesmanlike policy with reference to this factor of national welfare may be considered as well founded. Every civilized government must in time own or control the forest cover of the mountains, in order to secure desirable forest conditions.

The Scrub Lands of Australia.—The London Times's correspondent, in his little book on Queensland, mentions the "lawyer vine" as the worst obstacle which the clearer of land in that country has to encounter. It is a kind of palm that grows in feathery tufts along a pliant stalk, and festoons itself as a creeper upon other trees. From beneath the tufts of leaves the vine throws down trailing suckers as thick as stout cords, armed with sets of sharp red barbs. These suckers sometimes throw themselves from tree to tree across a road that has not been lately used, and make it as impassable to horses as so many strands of barbed wire. When the vines escape from the undergrowth of wild ginger and tree-fern and stinging bush that fringes the scrub and coil themselves in loose loops upon the ground, they become dangerous traps for man and horse. In the jungle, where they weave themselves in and out of the upright growths, they form a net that at times defies every means of destruction but fire. The work of clearing ground thus encumbered is not light. In some districts it is done by Chinamen. They are not allowed to own freehold land in the colony, but scrub land is often leased to them to clear and use for a certain number of years. The ground, when it is cleared, is extraordinarily rich, and they appear to recoup themselves for their labor with the first crops they grow upon their leaseholds. The owner afterward has it in his power to resume his land, and the Chinaman passes on to clear and use the scrub. In this way the Chinese are employed as a sort of self-acting machine for the opening of the country. They devote themselves principally to the cultivation of fruit. A walk round a Chinese garden is an instructive botanical excursion, so many and strange are the edible varieties of fruit to which one is introduced. Spices, too, and flowers flourish under the care of the Chinamen, and the

fields of bananas and pineapples dotted with orange and mango orchards, which stretch for miles beside the sugar plantations, are nearly all Chinese. They ship fruit to the southern colonies, but their profits must be very small, for one of the principal complaints made against them is that they can make a living where a white man would starve. Nevertheless, it is found that when they hire themselves out to work they are not a very great deal cheaper than white men.

Worlds and Molecules.—In his lectures at Geneva and Lausanne, M. Raoul Pictet presented mechanics as an exact science, comprising chemistry and physics in its domain. The principal phenomenon of physics is astronomy. The laws of sidereal gravitation apply likewise to the smallest bodies on the earth, to infinitely small ones like the molecules, and also to the atoms. Thus we have a unity of matter in which atoms, uniting from molecules, these group themselves into bodies, and these form worlds. The attraction which controls infinitely large bodies may therefore be regarded as similar to that which unites infinitely little ones. If the atoms touched in a molecule, there would be no force capable of separating them. We are, however, acquainted with dilatation and various ways of separating the atoms and augmenting the distance between them. The hypothesis that they touch is, therefore, not admissible. To explain the theory of chemical phenomena, let us suppose a molecule, A, placed somewhere in sidereal space, having a rectilineal motion toward another molecule, B, immovable, and very remote. In its approach to B there will come a moment when A's motion will slacken. Then astronomical phenomena will end and the phenomena special to physics will begin. At last the molecule A will stop; it has become inert, and can not advance further toward B. It is bound by cohesion. If, now, we suppose a pressure to be imposed on A, to bring it down to B, physical phenomena will cease, the resistance of A will diminish with the distance, and finally the molecule will ally itself with B without touching it; then we have chemical phenomena. The force that unites A and B is affinity. M. Pictet supposes that the absolute zero of temperature, when bodies can no longer react upon one another, is found between these last two phases, and his idea is confirmed by experiment. When sulphuric acid with potash is cooled down to — 150° C. (— 236° Fahr.), no reaction is apparent. The bodies are no longer able to combine at that temperature, when occurs a complete death of such action. At — 80° C. (— 112° Fahr.), potassium remains unattacked in alcohol and water for whole days. A slight warming produces a small reaction; and if the temperature is raised a little more, combination takes place with energy and an explosion is produced.

Heating and Ventilation of Electric-lighted Buildings.—In his paper on the Heating of Large Buildings, A. R. Wolff, consulting engineer, shows that the introduction of electric lighting with isolated generating plants in large buildings has had a sensible effect on the solution of the heating and ventilating problem by practically conditioning the use of exhaust steam for heating. The quantity of steam required for heating such buildings is nearly equal to the amount used independently for their electric lighting. Since electric-light engines convert only about ten or fifteen per cent of the heat of the steam with which they are supplied into mechanical energy, from eighty-five to ninety per cent of it is retained in the exhaust steam, available and just sufficient, as a rule, to meet the heating and ventilating needs of the building. This means practically that a boiler capacity ample for the heating and ventilating will take care, in addition, of the electric lighting of a large building, or *vice versa;* and that in the winter months the electric lighting is secured at only a slightly increased fuel expense. It is this fact that makes it difficult for either city or district heating or electric-lighting companies to supply steam or electricity respectively to large buildings. They can not compete with the cheapness of generation of the isolated plant within the building. The facts that electric lights give out less heat and vitiate the atmosphere less than gas, and that they do not flicker, have also an important bearing on the problem of heating and ventilation. The fresh-air supply can be brought in at the top of the room, where there are no lights for it to blow out, and ex-

hausted at the bottom, in reversal of the ordinary process, and under this condition it does not produce the draft or cause the sudden cooling that are so objectionable under the usual method of ventilation.

Work of the United States Fish Commission.—In the work of the United States Commission of Fish and Fisheries, the summer of 1890 was spent by the steamer Albatross in Bering Sea, where the principal banks frequented by the cod were surveyed. The season was too short to complete the work, and it will have to be resumed at some future time. The position of the western margin of the continental platform was, however, defined for a considerable distance, and a good beginning was made toward a knowledge of those physical and biological features of the sea which relate to the habits and distribution of the fur seal and other aquatic mammals. By the surveys of the coasts of Washington, Oregon, and California, the contour of the continental border has been developed from the shore line into depths of two hundred fathoms as far south as Point Conception, while the region between that place and San Diego had been previously explored. Temperature, density, and biological observations in different parts of San Francisco Bay indicate that the waters of that region are not, as has hitherto been supposed, unsuited to the breeding of Atlantic coast oysters. A scientific investigation was made with the Albatross during the early part of 1891, under the direction of Prof. Alexander Agassiz, of the waters lying off the western coast of America between Cape San Francisco and the Galapagos Islands on the south and the Gulf of California on the north. The most extensive and important operations on the Atlantic coast were conducted in the interest of the oyster industry, in the coast waters of South Carolina and Maryland and Virginia, and in Long Island Sound. Dr. Bashford Dean, of Columbia College, was commissioned to study the methods of oyster culture practiced in European countries and to prepare a series of illustrated reports concerning them. The physical inquiries in the mackerel region off the southern New England coast, under the direction of Prof. William Libby, Jr., were continued in 1889 and 1890; and the investigations respecting the interior waters of the country were conducted in twelve States and Territories on an extensive scale and with important practical results. The work of the Division of Fish Culture was continued at twenty-two stations in fifteen States.

The Theory of Special Assessments.—According to the study of this subject made by Victor Rosewater (Columbia College Series), the underlying principle of special assessment for benefit first appeared in this country in the provisions of a provincial law of New York in the year 1691. The effective clause of this statute was copied from an English act passed in 1667, and re-enacted in 1670, to regulate the rebuilding of London after the great fire. Thus the idea was not, as some have supposed, a native American one, but the substance of the plan had been put into English books twenty years before. The New York law remained unrepealed, but inoperative, till 1787, when it was adapted more closely to existing necessities. This method of raising revenue for local improvements remained for a long time peculiar to New York. It did not begin to extend to the other commonwealths till after the people had begun to recover from the effects of the War of 1812. The first development of the system, therefore, corresponds roughly with the movements for the construction of internal improvements covering the years just before and after 1830, and dying out with the crisis of 1837. The era of premature railway building about 1850 witnessed another movement of the kind in the newer States and Territories. The last movement, begun immediately after the close of the civil war, was more general than the others; has not yet wholly ceased; and has passed over into Toronto, Canada. The justification of the policy of special assessments is to be found in the principle that where an expense is to be incurred by a local authority which results in special, distinct, and measurable advantages to the property of particular persons, it is more equitable that those who benefit thereby should contribute to the expense to the extent of those benefits than that the burden should be placed upon others who have received no such special advantages. Among other methods of recovering the expense of improvements, besides

general taxation, are the imposition of tolls, which has now been generally abandoned, and recoupment, or buying the property before the improvement is made—as in the opening of new streets and public places—and reselling it afterward, which involves a large outlay of capital, and runs counter to the generally existing constitutional provisions respecting the exercise of eminent domain. For young and growing municipalities the method of special assessment is considered the best. "With few exceptions and abuses, it has been operated in the United States to the general satisfaction of all. It rests upon principles of right and justice. It brings quick results at the very time when needed. It discourages the speculative holding of unimproved urban property."

Characteristics of Lunar Craters.—In the study of lunar physiography or physiognomy, says Prof. G. K. Gilbert, interest naturally centers in the craters, for these are the dominant features. All theories begin with them. Their range in size is great, extending from a maximum of about eight hundred miles in diameter to a minimum of less than one mile. The size of the smallest ones is not known, as they are beyond the present power of the telescope. Within this range are several varieties, more or less correlated in size, but their intergradation is so perfect that they are all regarded as phases of a single type. To describe them one should picture to himself a circular plain, ten, twenty, fifty, or one hundred miles in diameter, surrounded by an acclivity which everywhere rises steeply but irregularly to a rude terrace, above which is a circular cliff likewise facing inward toward the plain. This cliff is the inner face of a rugged, compound, annular ridge, composed of shorter ridges which overlap one another, but all trend concentrically. Seen from above, this ridge calls to mind a wreath, and it has been so named. From the outer edge of the wreath a gentle slope descends in all directions to the general surface of the moon, which it is convenient here to call the outer plain. The outer slope of the crater may be identical in surface character with the outer plain, or it may be radially and somewhat delicately ridged as though by streams of lava. The inner slope from the base of the cliff to the margin of the inner plain is broken by uneven and discontinuous terraces. From the center of the inner plain rises a hill or mountain, sometimes symmetric but usually irregular and crowned by several peaks. From the outer plain to the base of the wreath the ascent is one thousand to two thousand feet, and the ascent thence to the top of the wreath may be as much more. The descent from the wreath to the inner plain is ordinarily from five thousand to ten thousand feet, and the height of the central hill is from one thousand to five thousand feet. With rare exceptions the inner plain is several thousand feet lower than the outer plain. The central hill is not universally present, but appears in rather more than half the craters of medium size, and tends to disappear as the craters become larger. Mr. Gilbert attempts to account for the origin of these craters by collisions of meteoric bodies with the moon, or of the moonlets by the aggregation of which under the meteoric theory the moon has been formed, and is supported by the fact that the splash produced by dropping a pebble into pasty mud, etc., has the form of a crater.

The Royal Cinnamon of Tonkin.—The cinnamon of Thanh-Hoa, Tonkin, called royal cinnamon, is highly esteemed by the Annamites, and great value is attached to pieces of its bark as presents. It is not cultivated, but grows in thick, hardly accessible forests on the Muong Mountains, where some cantons are tributary to Annam. Each canton must furnish the king a tribute of three stools of cinnamon a year. When an inhabitant learns of a stool, he immediately informs the mayor of his village; the mayor informs the sub-prefect, and he advises the governor of the province of the fact, who makes report of the matter to the court. The Quang phu, or sub-prefect, sends a squad of men to guard the tree, who are not relieved till the crop is gathered, in the presence of the Quang phu or of some mandarin deputized by him. The whole crop is supposed to go to the king, but the officers know how to retain a little of it. So precious a spice as is this particular kind has not entered into commerce, and so jealously is it guarded that it is extremely difficult to

obtain a specimen except through some fraud; and persons detected in defrauding the government of its cinnamon usually have to atone for the offense with their lives.

A Himalayan Landscape.—Mr. W. M. Conway, the Himalayan explorer, describes the view as an astonishing one which surrounds the traveler from Srinagar to Gilgit when he has emerged from the defiles which sunder the valley of Hunza Nagyr from Gilgit, and has climbed the vast ancient moraines near Tashot that form the final rampart of the fertile basin. "The bottom of the valley is, as usual, deeply furrowed by *débris*, the surface of which is covered by terraced fields, faced with Cyclopean masonry, and rich with growing crops and countless fruit trees. The mountains fling themselves aloft on either hand with astounding precipitousness, as it were, into the uppermost heights of heaven—so steeply, in fact, that a spring avalanche falling from the summit of Rakipershi on the south must almost reach the bottom of the valley. Rakipershi is 25,500 feet high; the Hunza peak is about 24,000 feet high. Their summits are separated by a distance of nineteen miles. Both mountains are visible from base to summit at one and the same time from the level floor of the valley between them, which is not more than 7,000 feet above the sea. No mountain view I saw in the Karakorums surpasses this for grim wonder of colossal scale, combined with savage grandeur of form and contrast of smiling foreground."

Composition of Clays.—The word clay, says Mr. Robert T. Hill, in his paper (United States Geological Survey) on the Clay Materials of the United States, has a diverse and elastic meaning. To the popular mind it is the familiar, gritless, plastic earth which is readily molded when wet. To the manufacturer it is the material he molds and bakes, which may be the natural plastic material of the popular mind, or a mixture of many ingredients either natural or artificial, according to the refinement of the ultimate product; this product varies as to simplicity of processes from the ordinary brick clays, which are natural mixtures of the essential sand and clay with iron and other accessories, to the washed, ground, screened, and compressed mixture of kaolin, feldspar, flint, and plastic clay from which the potter shapes china and porcelain into works of art. Clay material in nature is not always plastic, and many of the most valuable products are made from consolidated rock, as the Cornwall stone or rock kaolin, which is a crumbling granite. Many common brick clays are more like impure sand than clay, and some of these, from the earliest times, have been molded with straw to give them sufficient tenacity for the handling necessary before burning. Much of the aboriginal pottery of America is composed of various earths, with just enough clay to hold the particles together. The chief function of clay in the fictile arts is its partial fusion upon firing, and upon this and the skill of the artisan who fires the kiln depends the product, which is wonderfully varied by the mixtures of fluxes and tempering material. Plasticity is desirable for the handling of the unfired material. Nearly all unconsolidated or powdered material may be made to adhere by water and other ingredients than clay, so that it can be shaped for burning, but plastic clay is the cheapest natural material used for this purpose in all clay burning. The material for the coarse products occurs naturally, and is mixed with the non-plastic kaolins by the porcelain-maker to give the "clay" the necessary tenacity for handling and shaping.

NOTES.

An Experimental Study, by William O. Krohn, of simultaneous stimulations of the sense of touch, made upon ten different persons, among its interesting results showed that skin over the joints is much more sensitive than at other places; that touches on the back of the body are more distinctly felt, more clearly remembered, and therefore better localized than on the front part of the body; that the localizations are better for points not on the median line than for those on it; that they are not so correctly made on the left as on the right side of the body; that they are better on hairy portions than on those not covered with hairs; and that a difference in the power of correct localization exists between usually clothed and usually unclothed parts; the parts not covered, except in case of the joints, giving the more correct localizations.

By exposing hen's eggs to the vapors of alcohol for periods ranging from twenty-six to forty-eight hours, M. Ch. Féré has ascer-

tained that their development is much retarded and often results in the production of monstrosities. In some instances alcoholized eggs of nearly a hundred hours were hardly as far developed as normal eggs of twenty hours. These facts may be regarded as having a bearing on the frequency of sterility and premature abortions in human beings afflicted with alcoholism. They show, further, that alcohol may have an effect on the embryo, even when the progenitors have not been subject to chronic alcoholism.

THE character of the writing found in the Maya codices and inscriptions has been a topic of discussion among students of the subject, and three theories have been sustained: one that the symbols are ideographic; another, that they are chiefly phonetic; and a third, or middle theory, by Dr. Brinton, that they are in the nature of rebus-writing, or "iconomatic." The personal statements of certain old Spanish writers — particularly of Bishop Landa, who assumed to publish the alphabet — are in favor of their phonetic character. This is also maintained in a recent paper—Are the Maya Hieroglyphics Phonetic?—by Dr. Cyrus Thomas, who presents interpretations which, he believes, if they are accepted, will settle the question.

AT the last annual meeting of the New York Society for the Suppression of Vice, the president, Mr. Samuel Colgate, spoke of the encouragements that existed for the continuance of the work. The money receipts for the year 1892 had been equal to those of any previous year. The large proportion of prisoners convicted to the number brought to trial is cited as showing that the society is careful in instituting prosecutions. Several evidences were cited to show that the society had been brought into closer touch with public sympathy than ever before; among them was the fact that the year had been exceptionally free from newspaper assaults and adverse criticisms. Yet defects in the law needing amendment, and even legislation in favor of vice, and frequent laxity in the administration of existing laws, were complained of.

A UNIVERSITY course of thirty lectures on Celestial Mechanics, by G. W. Hill, is now in progress, beginning October 14, 1893, at Hamilton Hall, Columbia College. The lectures are given every Saturday except the last two in December, at 10.30 A. M. A full presentation of the subject is given, rather than a rapid summary.

M. JANSSEN has telegraphed the fact that the observatory on the summit of Mont Blanc is completed, and nothing now remains to be done but carry out the interior arrangements. The machinery adopted for hauling materials up over the snow worked to perfection and contributed greatly to the success and comfort of the workmen. M. Janssen used it to assist in his own getting up, and it was "curious, extraordinary," he says, "to see materials moved by these engines climbing over the icy slopes of the peak by ways of a new sort, which science only was able to contrive and realize."

IN an interference experiment described by Lord Rayleigh the light from a single slit, illuminated either by sunlight or a lamp flame, passes down a tube about a foot long and is received on two very fine and very close slits. An eye placed at the back of these sees a beautiful set of interference bands. No lens is required, because the eye itself acts as such. The two slits are really scratches made by a knife on an evenly silvered microscope cover-glass.

THE consultative committee appointed in Italy to study the question of alcoholism has recently presented its report to the Government. It appears from the document that the yearly mortality ascribed to alcoholism for the whole kingdom is 1·62 per hundred thousand inhabitants. It was greatest in Liguria (3·46) and the March (3·11), and least in Campania (0·53) and the Abruzzi (0·75). Under the application of the new penal code, which makes intoxication a crime, 16,504 offenses were reported in 1890 and 16,382 in 1891.

IN a paper on the wearing of rings in ancient Rome, M. Maximin Deloche shows that in the early days of the republic the iron ring was reserved for persons who had distinguished themselves by some splendid act in war or had rendered the state some important service. Afterward, patricians, knights, and magistrates had the privilege of wearing it. When the wearing of rings became general the metal used became the distinctive sign of the several classes of citizens, and the metal worn was determined by birth. The most precious metals were worn by the *ingenui*; senators and knights alone had golden rings; while the plebeians' rings were of iron. The freedmen in time made claims to the privilege of wearing gold, and it was given to them by a constitution of Justinian.

NOTICING the fact that the Smithsonian Institution has obtained a table in the Zoological Laboratory at Naples, the Revue Scientifique remarks that it is curious that Americans should go to Europe to seek subjects for study when they have so abundant and varied a fauna at home.

A MANUFACTORY of flints for guns and tinder boxes still exists at Brandon, England, in which, according to Mr. Edward Lovett, the methods supposed to have been used in the stone age are employed without much change at the present time. The flint is broken into conveniently sized fragments by placing it on the knees and striking with a hammer. The pieces are then split into flakes, and these into squares, which are trimmed into

finished gun flints. Most of the gun flints are sent to Zanzibar and African ports, and the tinder-box flints to Spain and Italy.

A THEORY has been put forth by M. Rateau in the French Academy of Sciences that the crust of the earth beneath the continents does not touch the fluid globe, but is separated from it by a space filled with gaseous matter under pressure. The continents would therefore constitute a sort of blister, much flattened, inflated and sustained by gases, while the bottom of the oceans is supposed to rest directly on the fiery mass. By this hypothesis the author believes that many phenomena of the terrestrial crust may be explained which are not clearly accounted for under the present theory.

A RAPID deterioration is described by Mr. C. H. Morse as being produced in the water pipes of Cambridge, Mass., by the electrolytic action of the current from the electric cars. It is observed in pipes composed of lead, iron, galvanized iron, brass, and rustless iron. In one instance the current was so strong as to set on fire oakum which was applied in making a joint. A partial check to the deterioration has been found in connecting the water and gas pipes and the negative pole of the dynamo.

THE Bank of France has put in circulation notes printed on ramie paper. The notes are of the same form as the old-fashioned ones, but the new paper is lighter and at the same time firmer than the old, and permits a clearer impression, rendering counterfeiting more difficult.

UNDER the Thibetan system of polyandry, as observed by Mrs. Bishop (Isabella Bird), the eldest son alone of the family marries, and the wife accepts the brothers of her husband as secondary spouses. The whole family is thus held to the home. The children belong to the elder brother, while the other brothers are "lesser fathers." The natives are strongly attached to this custom. The women, in particular, despise the monotony of European monogamy, and the word "widow" is a term of reproach among them. Children are very obedient to their fathers and their mother, and the family feeling is strongly developed.

STRONG additional evidence of the presence of cretaceous strata beneath the most of Long Island is adduced by Mr. Arthur Hollick, in a paper on that subject. They have been found in the shape of fossil remains of plants at Williamsburgh, Lloyd's Neck, and Glencove. Clays containing the fossils have been found in place in the neighborhood of Glencove; while at other sites the rocks appear to have been glacially transported. "Only a beginning," says Mr. Hollick, "has yet been made in the search for plant remains; but now that attention has been called to the matter they are being reported from a number of localities, and specimens are constantly coming to the light, and there seems to be no doubt that the entire north shore of the island will present the same story to the searchers when it has been carefully explored."

TREES in London, as in other cities, have two adverse influences to resist—coal smoke and the heat reflected from miles of brick and stone work. The past unusually hot summer has afforded a fine opportunity for observing what species can most successfully contend against these influences. Among them Mr. Herbert MAXWELL names the Oriental plane tree, which has stood the trial fairly well, coming out with half its leaves gone and the other half fresh and green; aspens and poplars, which "have suffered not at all"; the ailantus, "which is (September 7th) in splendid foliage"; and our common locust (*Robinia pseudacacia*), which "for beauty of form or freshness of verdure can not be excelled for planting in towns."

OBITUARY NOTES.

TRAUGOTT FRIEDRICH KÜTZING, a pioneer in the scientific study of the Algæ, died at Nordhausen, September 9, 1893, in the eighty-seventh year of his age. His latest work is more than twenty years old, and all his most important works appeared before 1851. Yet, although much that he did and taught has been superseded or supplemented by more recent investigations, his *Phycologia generalis*, published in 1843; his *Tabulæ phycologiæ*, published in twenty volumes, 1845 to 1870; and his *Species Algarum*, 1849, are still standard works. His extensive collection of dried Algæ has long been in the possession of the University of Leyden.

DR. ALEXANDER STRAUCH, Director of the Zoölogical Museum of St. Petersburg, who died in September, 1893, at the age of sixty-one years, was an authority on reptiles and the author of several zoological works.

PROF. HERMAN AUGUST HAGEN, of Harvard College, a distinguished entomologist, died in Boston, Mass., November 9, 1893. He was born in Königsberg, Prussia, where his ancestors had been connected with the university for two hundred years, and, having pursued his studies there and at other places, settled there in the general practice of medicine. He was assistant in the surgical hospital there and incumbent of local civil offices when he was invited by Prof. Agassiz to come to Cambridge as assistant in entomology at the Museum of Comparative Zoölogy. In 1870 he was made Professor of Entomology at Harvard. His first scientific paper was published in 1834. His publications include more than four hundred articles, of which the most important is the Bibliotheca Entomologica.